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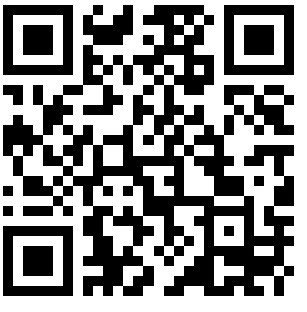

THE ELECTRICAL JOURNAL.

VOL. I.

J. ALLAN HORNSBY.

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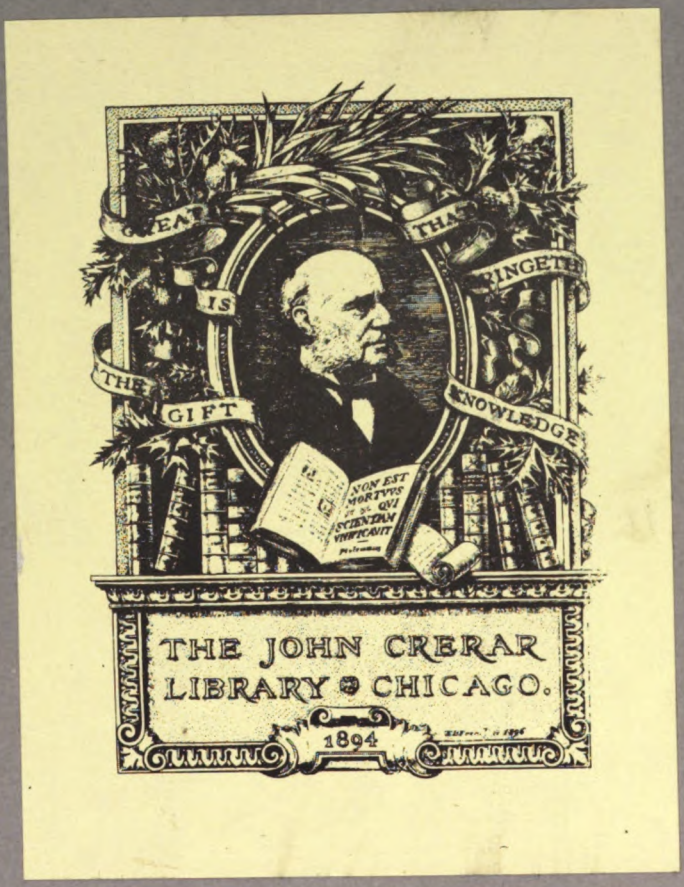

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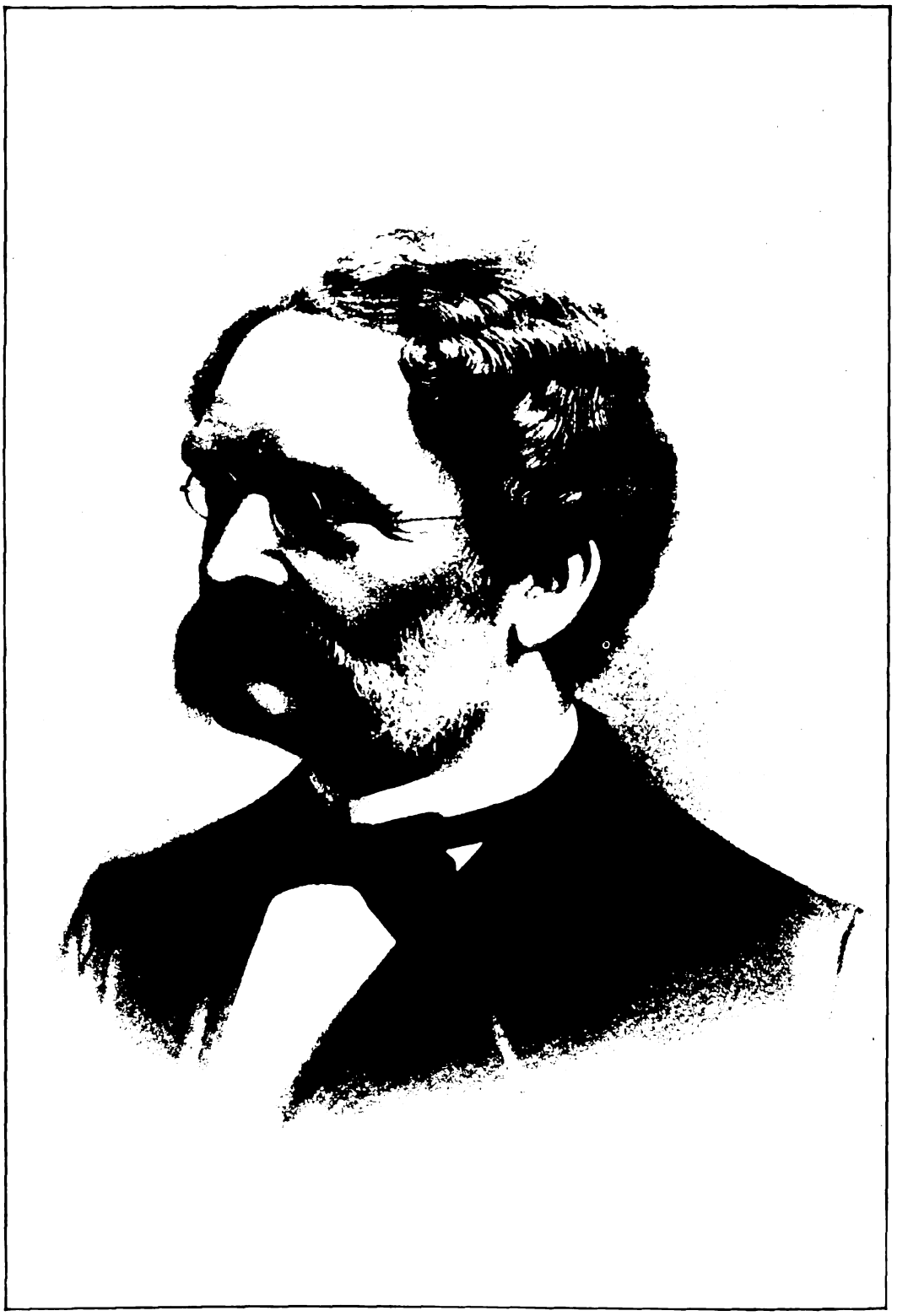

DR. ERNST WERNER VON SIEMENS.

Born at Lenthe, Hannover, Dec. 13th, 1816. Died at Charlottenburg, near Berlin, Dec. 6th, 1892. Founded in 1847 the great firm of Siemens and Halske. Inventor of the Dynamo-Electric Machine. Pioneer in Electric Traction, Electrolytic Refining of Metals, and a variety of Commercial Applications of Electricity. Built the first Electric Railway in 1879.

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The Electrical Journal.

Vol 1. CHICAGO, JUNE 1, 1895. No. 1.

ELECTRICAL FIRES IN CHICAGO.

Sixty-one Fires During the Past Year Cause Losses Aggregating Less Than Eight Thousand Dollars. Damaging Statements Disproven.

SOME OF THE DEFECTIVE WORK IN DETAIL.

I AM not of those who "view with alarm," existing conditions in electrical construction. When consideration is given to the rapidity of changes in the immediate past, in methods of electrical service, the introduction of the alternating current, and the necessity for economy in installation, growing out of business competition, there is every reason to concede that care and diligence have accompanied the evolution from the old to the new in electrical construction.

TWO 110 VOLT LAMPS IN SERIES ON 220 VOLT CIRCUIT.—SHORT CIRCUIT ON GAS FIXTURES.— 50 AMPERE FUSE.

It has become the fashion of the lay press to hold electricity responsible for every misfortune to life and property not easily and comfortably explained otherwise. Arson and criminal carelessness have become appreciably less common since electricity is at hand to assume the load of responsibility and odium. Fortunately for electrical interests, it has been possible to keep and tabulate statistics of fires in a number of localities for the past few years, and these figures, at least so far as they relate to the City of Chicago are extremely reassuring, as the following tables, taken from the report of the fire marshal of Chicago, for 1894, recently published, will show:

Causes.	Total No. Fires.	Loss From Each Cause.
Fuses (safety)	1	.....
Arc lamp hanger boards	2	.....
Incand. socket, short circuited	3	.....
Outside arc service switch	8	.....
High tension resistance box	1	$ 50.00
Motor commutator, show window	1	.....
Spark from arc lamp	4	70.00
Heated journal of motor	1	.....
Motor commutator burned 110 v	1	.....
Transformer burned out	1	.....
Lightning	1	.....
Street railway trolley	1	15.00
Revolving chandelier, short circuited	1	.....
Inside conductor, low tension	8	7200.00
Conductor under sidewalk, low tension	1	.....
Cable under river	1	300.00
Insulation of outside arc wire cut by broken insulator	1	.....
Outside arc wire defective—tie wire cut it	1	.....
Defective arc wire under sidewalk	10	.....
Outside arc light wire near sidewalk	1	.....
Nail driven thro' outside arc light wire	1	.....
Defective outside arc wire on building	10	5.00
Nail driven thro' inside arc light wire	1	.....
Total fires	61	
Total Loss		$7,640.00

The almost nominal loss indicated in this table is an eloquent refutation of a common charge, yet there is ample reason why the subject of electrical construction is a very live topic for discussion, and there is no doubt that much good will result therefrom.

In leading up to a well-guided discussion of the subject of electrical installation, the questions at issue should be broadly put, without the admixture of details.

The prime considerations in planning a piece of work are efficiency, safety, convenience and appearance. The opposing interests are necessarily the protection of life and property and the rights of others than the owners. In order to insure the consideration of all these essentials, there have been created in most well-advanced communities two organizations, namely, municipal electrical inspection departments and similar bodies operating under and in the interests of fire underwriters. The duties of both these bodies are largely police in character and their efficiency depends, in a great measure, upon the laws under which municipal inspectors exercise control, and in the case of the insurance auxiliaries upon the right of insurance companies to increase their rates when their requirements are not met. That there shall be no arbitrary and unreasonable conditions set up, rules have been created out of experience, and these rules are practically the same in all communities in this country where concerted action is in vogue.

It is my belief that the greatest of all dangers concerning electrical installation lies in the close and often ruinous competition of bidders on work. It has come to be almost common practice for bidders to take construction work at its actual cost to them, relying for their profit on possible so-called "extras." Such policy developes a demand for cheap construction, and where—as is the case in electrical construction—there are so many unsettled details of practice, it necessarily follows that bad work is done.

Of the sixty-one fires scheduled in the fore-going table, a large percentage were due to either defective or injured wire, outside or interior, arc or incandescent. The fires due to all other causes were few in number and the losses insignificant in amount. There is no reason why ordinary installation should increase fire hazard. We are sufficiently familiar with the laws of electricity, as applied in common practice, to provide against the usual dangers, and a careful study of the above table will show that obedience to the accepted rules for installation would have made impossible most if not all the fires tabulated. From one of these fires alone there was a loss of $7,000, and the records of the inspection department of the city state that only three days before the fire, the building was condemned and the manager was commanded to make repairs.

1000 VOLT CURRENT ON 50 VOLT WIRES. FIXTURE GROUNDED AND WIRES IN CONTACT WITH SOCKET.

As a rule, no technicalities have been insisted upon in prevailing rules, that the ordinarily skilled workman can not handle, and conformance with these rules, furnished everywhere, coupled with tabulated reports of fires and their causes, to be used as guides for avoiding past errors, should insure much better work than we have had in the past.

A few suggestions from my own experience may not be out of place.

Practice has demonstrated conclusively that wood of any description is not safe for bases of instruments where the live portions of circuits are mounted directly thereon.

The two prime factors essential, are insulation and non-combustability. In the following cut we see that these points

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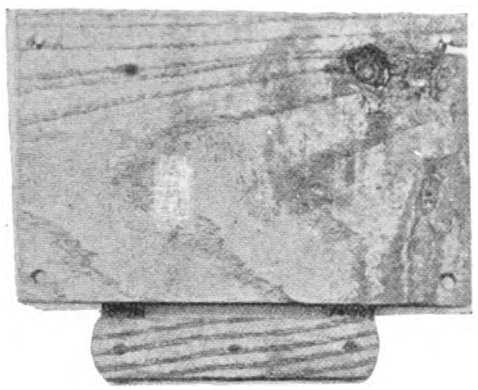
have both been disregarded; a result in low insulation and heating.

"Flexible cord," so called, is used not always because of necessity, but because with it cheaper or quicker work can be



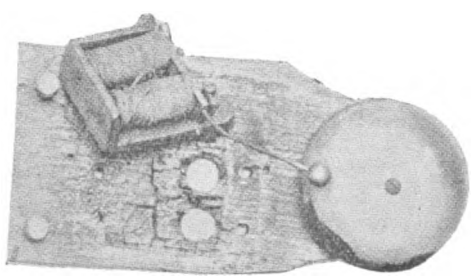
REAR VIEW OF WOODEN BASE SWITCH SERIES ARC CIRCUIT, SHOWING CHARRING IN UPPER RIGHT HAND CORNER.

done. The flexible cord made in years gone by and to-day, with exceptions, is simply nothing more, after a few months installation, than a conductor wrapped in cotton.

Accompanying is a cut showing the effect of electrolysis on gas pipe and water pipe. In case of the latter, there is danger of

WOODEN BASE SWITCH AND WOODEN BASE CUTOUTS BURNED FROM BLOWING OF FUSES AND FROM POOR CONTACT IN BINDING POSTS.

water waste and destruction of property from flooding. But in the former, there is a far greater danger—that of released gas



ANNUNCIATOR BELL AFTER CROSS BETWEEN BELL CIRCUIT AND GROUNDED LIGHTING CIRCUIT IN DWELLING HOUSE.

becoming ignited—followed by the explosions which we often attribute to spontaneous combustion and other convenient freaks of nature.

One of the first results of improvement in methods of installation will be to lower insurance rates, and it will not take owners of property long to find out that a few dollars extra is first installation will save many dollars in insurance, to leave out of con-

CUTOUT SWITCH SERIES ARC CIRCUIT.

sideration all the other misfortunes of fires, including possible loss of life, and the inconveniences of the interruption to business.

John P Barrett

* * *

Irrigation by Electricity.

Irrigation by electricity is to become an accomplished fact at San Bernardino, Cal., says the San Francisco Examiner. An electric light company has just perfected arrangements for an eight-mile circuit, which shall cover the farms and orchards to the north of the city, and by means of stationary pumps and movable motors the water for irrigating purposes will be raised and distributed. The plan is for the formation of small districts along the line of circuit, each district to have the use of a motor. It will be attached to a pump a certain number of hours, just as irrigating ditches are open for regular periods, then moved into the next field connected with the wire, the current turned on and each field in the district served in turn and as the water is needed. The scheme is the result of a peculiar condition in many parts of the valley, and if it works as the projectors contemplate will no doubt become universally used in districts where it is practicable. The ground and even the mountains which surround this valley are a huge sponge. The earth is full of water, and a well put down would find moisture in abundance. The problem has been to raise the water, but no means has been devised which was reliable and that was not expensive. Windmills were unreliable, while gasoline engines cost more to operate than it does to buy a water right from one of the irrigating companies. The cost of pumping by the electric motors is estimated at $1.55 per month per acre, or less than $7 per acre for the irrigating season at its longest. Water rights cost from $100 to $150 per acre, so that the cost of irrigating by the proposed method is less than the interest on the cost of a water right if purchased outright.

* * *

Final Tests of Niagara Power Plant.

The large plant of the Pittsburg Reduction Company at Niagara is being hurried to completion so that work may be commenced immediately after the initial tests have proven the success of the first series of 5, 00 horse power generators being installed by the Niagara Falls Power Company. These tests are expected to take place within the next few days. Beside the Pittsburg Reduction Company, the Carborundum Company located on the ground, and private plants in and about Buffalo are expected to utilize all the power available from the first installation of the Niagara Falls Company. If the computations of the management are realized, additional installation will be completed at once.

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STREET RAILWAY TROUBLES.

Ignorance and Carelessness the Main Causes. Improved Appliances, Careful Handling and Repairs are Necessary.

A STITCH IN TIME WILL OFTEN SAVE NINE.

ANY system for distributing power is sure to wear and to get out of order to some extent. The amount of trouble will depend to a very large degree upon the excellence of the design and construction by the maker and upon the skill and care of the user. The electrical apparatus used in street railway work to-day is stronger and more durable than that put out several years ago, and further improvements may be expected. It is important to consider some of the common causes of trouble and suggest methods of preventing it. Many of the sources of trouble are mechanical rather than electrical and need not at this time be considered in full.

Troubles may be divided into two general classes, those due to wear and depreciation, and those due to so-called accidents or unusual causes. The principal troubles of the latter class come from fire and lightning. One of the common sources of fire is the over-heating of conductors. This is avoided by making each conductor large enough to carry its full current without becoming so hot as to be uncomfortable to touch with the bare hand. Each circuit should be provided with fuses that will melt and open the circuit when the current increases beyond the safe limit.

If the current is greater than 300 amperes, a *magnetic circuit breaker* should be used. The circuit breaker consists of a switch held closed by a trigger which will be pulled back by a magnet so as to open the switch when the current becomes too

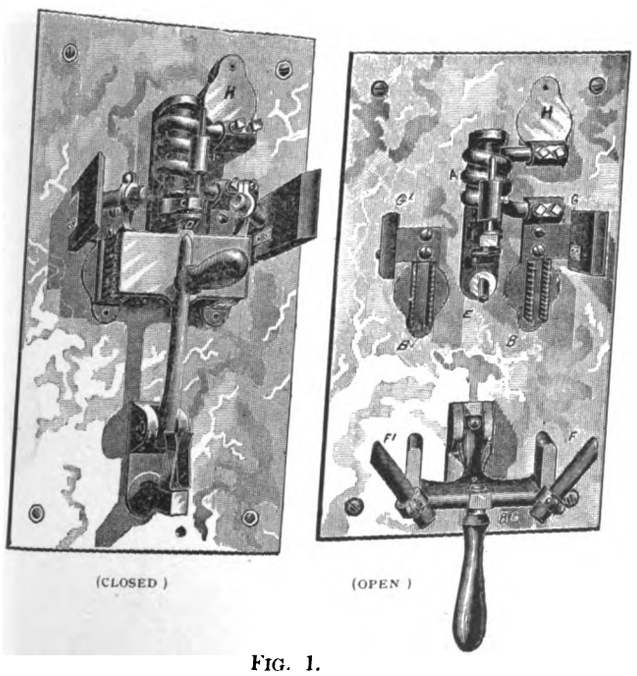

FIG. 1.

strong. Fig. 1 shows a common form for station use. The current comes in at *H*, passes through the coil *A* and goes out through the switch *B*, B^2, B^1. An adjustable weight regulates the current at which the armature of the magnet pulls the trigger so that the switch flies open. The contact is broken by the carbon blocks *G*, G^1 and the carbon pencils *F*, F^1 so that the metallic parts of the switch are not burned.

In addition to being protected by fuses and circuit breakers, each line and each piece of apparatus should be attached only to non-combustible supports of porcelain, slate, marble or glass, so that fire will not be caused by accidental over heating. The power-house and car barns should be built of iron and brick or other non-combustible material so far as possible. The rules of the insurance companies should be carefully observed as safeguards against fire.

Lightning is a common source of trouble by burning out dynamos and motors. The lines are sometimes actually struck by lightning from the clouds. More often the line becomes highly charged by electro-static induction from a passing cloud, or by electro-magnetic induction from a lightning flash. Such charges are often of a very high voltage and go to the earth by the easiest possible way. The charge is often oscillatory, or alternating, so that it meets great resistance in passing through a circuit having much self-induction. The charge from lightning will generally jump some distance through an insulating substance or will pass over a non-inductive path of very high

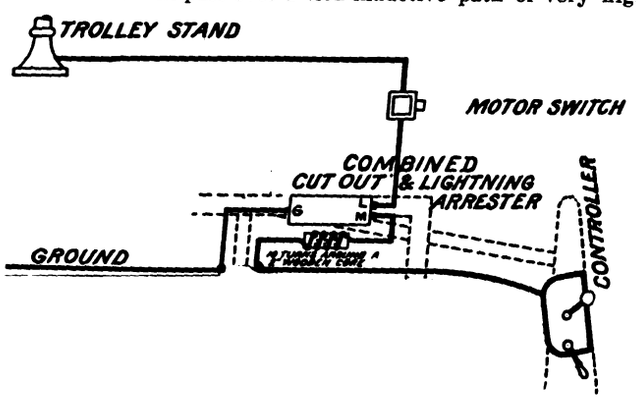

FIG. 2.

resistance, such as a pencil mark or a short air space, rather than pass through the circuit of a magnet. The way to get rid of such charges is to prepare a short and straight path to the ground separated from the line by a short insulating space (Fig. 2), so as not to ground the regular current. When the lightning jumps across such a space, it heats the air and burns the ends of the conductor, causing vapors that carry the working current across the space, and so ground and short-circuit the line or the machine. The lightning arresters must therefore provide some means for opening the curcuit immediately after the discharge, or else prevent the formation of such vapors.

A common form of arrester for cars consists simply of two pieces of carbon separated by about $\frac{1}{32}$ inch, one being connected to the truck or motor frame and the other connected to the circuit as indicated in Fig. 2. If lightning comes in and jumps across the carbons, the current from the trolley follows and melts the fuse. The trolley pole should be pulled down while the fuse is being replaced, lest another discharge should come and injure the motor man. The carborns should be firmly fastened and kept the proper distance apart so that they will not ground the line without lightning. The General Electric Co. places a magnet in such a position that the current across the air space must pass through the magnetic field. By the elementary principle of the electric motor, the current is pushed out of the magnetic field and the arc lengthens until it breaks. It is a good plan to have a non-inductive resistance in the ground circuit of lightning arresters in the stations and on the lines, in order to limit the current that follows a lightning discharge. The Westinghouse Co. makes a very simple and effective lightning arrester for railway circuits, in which the discharge is caused to pass between two brass plates separated half an inch by a block of lignum vitæ in which a number of narrow grooves have been burned. The lightning can leap across the charred surface, which has a resistance of more than 50,000 ohms. There is no chance for vapors to form and the resistance is too high for any appreciable current to pass from the trolley. A great many other forms of arresters have

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been tried, but these seem to be most satisfactory for railway work.

It is a good plan to have a coil of a few turns of wire between the lightning arrester and the motor or the dynamo. The resistance of this "kicking coil" or "choke coil" is so small as not to oppose the regular working current while it does offer a high inductive resistance to lightning discharges. A common method of connection in a kicking coil on a car is shown in Fig. 3.

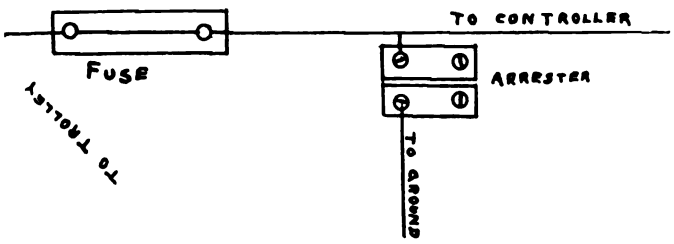

FIG. 3.

The lightning arrester should be connected to ground by the shortest and straightest path. An excellent method for grounding arresters is shown in Fig. 4. The ground wire is soldered to a brass plug screwed into the upper end of a gas pipe driven 10 or 12 feet into damp earth.

Troubles due to wear and age may be avoided to a large extent by careful handling, inspection and repair. The old maxim, "A stitch in time saves nine," is nowhere more true than on a street railway. The way to avoid troubles is to keep everything in good order. Troubles occur principally at the power house, on the line, on the track and on the cars.

Troubles at the power house come from short circuits, poor insulation, poor regulation of engines and dynamos, sparking and other causes peculiar to local conditions.

Troubles from the line are caused by the trolley wire breaking or getting too slack or out of line, especially at curves and turn-outs; by the ears or clips getting bent, so as to strike the trolley wheel and make it jump; by the hangers and other supports being too weak and bending or breaking; by snow or sleet preventing the trolley wheel from making good contact; by defective insulation; by the trolley wheel getting out of order. If the trolley wheel makes poor contact, there is sure to be more or less arcing and burning of trolley wire and wheels. This weakens the wire. If the wire is too slack the trolley will jump and arc at every clip, and will also bend the wire up and down, which in time will cause breaking. By giving the trolley wire a thin coating of vaseline or grease snow or sleet may be prevented from sticking to it and so causing arcing and burning.

Grounds and short-circuits on the line may be caused by telephone or other wires falling across the trolley wire; by the trolley breaking; by insulators being broken; by the feeder wires coming into contact with trees or other objects and so wearing off the insulation. Such troubles may be avoided by having the linemen and motormen watch the lines carefully and repairing or reporting anything found out of order. Some roads have linemen or other inspectors go over all of the lines every few days to find and remove any possible sources of trouble.

Troubles on the track may come from rails spreading, ties battering and rotting, poor ballasting, low joints, loose joints, broken or loose bonds, dirt, mud and snow. The remedies for most of these are plain. Loose or broken bonds between the rails cause increased resistance and loss of pressure; they may be found by connecting a low-reading voltmeter to the two rails before and after a car has passed. The heat caused by the high resistance will sometimes melt the snow at the spot, or make the ground dry quicker after being wet. If the bonds are broken at both ends, the rails become "dead" and the wheels will flash and the lights in the car will become dim or go out. The car will not start if it stops on dead rails.

Dust and sand are insulators and prevent electrical contact between the wheels and the rails. Dry snow is an insulator and it also causes the wheels to slip. Moisture on the tracks improves the electrical contact between the wheels and the rails, and also makes it easier for the cars to round curves.

Most of the causes of trouble with the electrical part of the cars is mechanical. The motorman should look out for hot bearings, especially on the armature and axle-boxes, and at the trolley. Hot bearings may be caused by mud or sand, by poor lubrication or by being too tight. The caps should not be screwed down so tightly as to bind the shaft, and should allow some end play. Care should be taken not to let the armature bearings get too loose or too much worn or there will be danger of the armature striking the polepieces, stripping off the insulation and also the armature wires, grounding the motor and destroying the armature. Worn armature bearings may be be detected by lifting the armature, first at one end and then at the other. Too much play in the armature and axle-boxes is also liable to throw the gears out of adjustment and may cause them to strip off the teeth. If the trolley wheel is not properly lubricated, or is pressed too hard against the wire it will heat. If the pole spring is too loose the trolley will jump and arc badly.

All bolts, nuts and screws, especially about the motors and trucks, should be examined to see that they do not become loose or drop off. Loose bolts and nuts are liable to get caught in the gears or armature and cause trouble.

Every day the motorman or inspector should examine the connections of motors, trolley, lightning arrester, fuse blocks, controller and rheostat. Poor contact at any connection causes

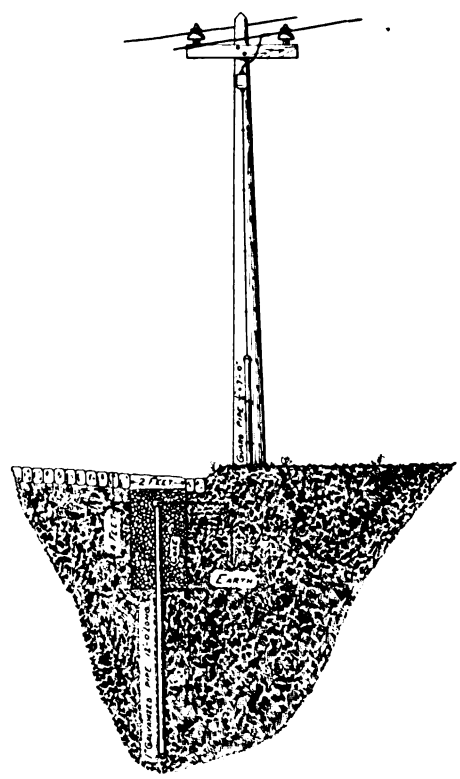

FIG. 4.

heating and loss of power. The connections may come entirely apart or burn off, causing much trouble. Loose or broken connections are the most common causes of trouble.

Special care should be taken to secure good contact between the commutator and brushes. The brush holders should be kept clean and tight. The entire end of each brush should fit perfectly on the commutator. Each brush should have a small amount of play in the holder, and the spring should press it firmly, but not too hard against the commutator. The commutator should be kept clean and true as possible. It should be slightly oiled occasionally and should keep a glossy appearance.

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If it gets rough or gummy it should be cleaned with sand paper. Sometimes a bar may become higher or lower than the others, usually on account of the collar and nut at the end becoming loose. A high bar may sometimes be driven into place by a block of wood and a hammer, or it may be filed or turned down. For low bars the lathe is needed.

If the brushes and commutator are in good condition sparking may be caused by brush holders not being set in the proper position. An open circuit in an armature (usually in the connections between the commutator and the coils) will cause a greenish flash that will appear to go around the commutator. When the motor is running slowly this will appear first at one brush and then at the other. A short circuit in the armature will also cause it to spark in much the same way, but it will generally blow the fuse, and burn the short circuited coils.

Sparking or flashing will also occur if the armature is taking too much current. In this case the armature and fields will be hot. This may come from pulling too heavy a load, or from the magnetic field being too weak as a result of wrong connections or short-circuited coils. The connections of the field coils may be tested by sending current through each one separately and trying the polarity of the field magnet by means of a pocket compass or a piece of magnetized steel. A single armature coil may be short-circuited by carbon or copper chips between two commutator bars. Such a coil will act as a dynamo on short-circuit and will become much hotter than other coils, and may *burn out.*

Sparking and flashing at the brushes are to be avoided for several reasons. It means waste of power and rapid burning of commutator and brushes. It may mean some serious trouble in the motor. It may cause the motor to *buck*, sometimes with serious or even fatal results.

Bucking is much less common than formerly. Sometimes an electric car will stop suddenly, as if by a collision, and then may go on again for some distance as if nothing had happened, or it may refuse to go at all. There are all degrees of bucking, from a small jerk to a severe one. Bucking is caused by one or both of the motors becoming a dynamo. This will occur whenever any part of the circuit between the grounded armature brush and the field becomes grounded.

For a simple case, suppose the lead wire between the field coils and the armature has its insulation worn off and the bare wire touches the motor frame or some grounded part of the car. The circuit is thus closed from the field coil through the defective wire to the ground. The current through the field becomes much greater; because the resistance and counter-electromotive-force of the armature are cut out, and causes a very strong magnetic field. The armature is now connected with the ground on one side by the regular ground connection and on the other side by the defective wire, as shown in Fig. 5.

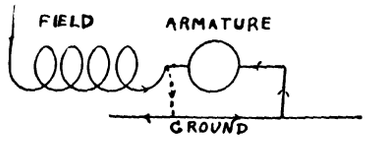

Fig. 5.

Since it is generating a high electromotive force by revolving in a strong magnetic field, and is also short-circuited by the two ground connections, it generates an enormous current. This quickly turns the energy of the moving car into electrical energy and stops the car suddenly.

Bucking may also be caused by excessive flashing at the brushes, the flame from the positive carbon jumping across to the other carbon, or to the commutator collar, to the brush yoke or to the frame. The same effect may be caused by mud, water, carbon dust on the commutator or brush-holder, by a wire sticking up from the road, by a ground on the armature or field coils, or by other similar causes. Examination of a bucking motor often shows blisters and pitting on the collar at the end of the commutator and on the brush yoke and brush-holders caused by the flashing. The cure for bucking is generally to keep the brushes and commutators in good condition so as not to spark badly, and to keep all parts of the electrical circuits clean and well insulated.

Bucking sometimes occurs on cars having two motors which are connected to one another between the armatures and the fields, as when a single reversing switch is used for both motors. This case is somewhat complicated and as such bucking is never very severe, it will not be discussed.

If a car refuses to start, the motorman should know how to locate the trouble and how to remove it. He should make a careful study of the particular apparatus he is using, but the following directions prepared by one of the large companies, will be of general application:

(1.) If there is no evidence of current, notice other cars. If they are all right the trouble is in your own car.

(2.) Throw on lamp circuit. If the lamps light up, the trolley and ground wires are all right. Now work controller; if the lights go down or out, the trouble is probably due to poor contact between the wheels and the rails, or the section of track on which the car is standing may be "dead."

(3.) Ascertain whether the fuse has been blown. If so, throw the canopy switch and put in a new fuse.

(4.) *See that both motor cut-outs are in place.*

(5.) Try both controllers; if one works, the trouble is probably due to poor contact in the other. In this case throw canopy switch, remove the cover of the controller and examine the contact blocks to see whether they all make proper contact.

(6.) Examine the brushes of the motors to see that they are not broken and that they make good contact.

(7.) If the car is on a dirty rail, take a piece of *insulated* wire and make connections with it by holding one end on the rail and the other on the wheel. Break contact with the wheel first, or you may receive a shock. The rail may be "dead" that is, in poor electrical connection with the rest of the track. In that case make the same connection between wheel or "dead" rail and nearest "live" rail.

In case the current is shut off at the station for any reason while the car is running, bring the controller to "off" position immediately. Then turn on light circuit and wait until the lamps light up; when they have reached their usual brilliancy, start the car. Do not leave the controller on, while waiting for the current. Do not try to start while the lamps are only red, but wait until they become bright.

ANOTHER BIG PLANT AT NIAGARA FALLS.

World's Fair Water Power Exhibit Takes Practical Form—Will Bridge The Niagara River.

Alonzo C. Mather of Chicago is to be granted a concession by the city of Buffalo and the state of New York to bridge the Niagara River for the purpose of building an electric power and light plant, to operate by water power. The system calls for an undershot wheel, geared to generators located on the bridge.

World's Fair visitors will remember an elevated exhibit in the northeast part of the electrical building, composed of an artificial canal surrounding an island of ferns and vines, boats occupying the canal, and on the outside of the canal a model railway fitted with cars—the boats and cars being run by electricity with power from a water wheel at one end of the oval shaped island.

The exhibit represented a system of electric railway and canal transportation invented by A. C. Mather of Chicago. There were little plats of white flowers along the canal which represented Buffalo and other cities along its route.

For several years the inventor, with the perseverance for which inventors are noted, worked quietly on his plans, and when the World's Fair came on, was ready to exhibit. As soon as he had got his exhibit ready, some eastern capitalists sent their experts to Chicago to see the system at work. He was afraid they intended to steal his invention.

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ELECTRICITY IN MEDICINE.

Physiological Action of Electrical Currents—Electrolysis—Cataphoresis—Induced Currents—The Cautery—Light.

SUMMARY OF RECENT SCIENTIFIC WORK.

Electricity in medical and surgical application does not differ in nature or principle from that manifestation of it which we are accustomed to associate with light, and heat and power in commerce. Its application only is different and the apparatus employed is modified to bring about special results.

For commercial practice dynamic or current electricity is broadly divided into two kinds, so called because of the two methods of manifestation. The physician has been accustomed to call these two forms galvanic and faradic electricity. The galvanic current, as we have been accustomed to call it, is in commercial use, employed in the lighting of the ordinary electric lamps and in the driving of electric motors. This current the physicist calls the direct current because the flow is continuous and only in one direction. The faradic current which the physicist is now developing with great rapidity is being put into commercial practice for many of the uses heretofore monopolized by the direct current. This faradic current the physicist calls the induced current or often the alternating current for the reason that the flow of the current in the circuit alternates in the two directions. A third manifestation of electricity is known to physicists as electricity at rest or static electricity, the properties of which are sufficiently well-defined to merit a separate article in the near future. For the present we will discuss electricity only as it manifests itself in current form or in dynamic state.

For therapeutic purposes direct current or galvanism electricity can be used to bring about physical, mechanical or logical effects. Among the physical effects we may mention electrolysis, electric endosmose or cataphoresis and the production of heat as used in the galvano-cautery and the electric light.

In electrolysis, which by the way may be described as the reverse of chemical affinity, liquid compounds—which are conductors—are broken up into their chemical elements. Some of these elements migrate toward the positive or anodal electrode, and others toward the negative or cathodal electrode. In the separation of these liquid compounds the acids and oxygen are always attracted toward the anode or positive electrode, and the alkalies and metals are always attracted toward the cathode or negative electrode. In the breaking up of water, oxygen finds its way to the anode, and is there released either into the atmosphere or for chemical affiliation with other matter, while the hydrogen migrates toward the cathode for escape or re-combination at that point. This is in brief electrolysis, and is the process upon which all electroplating, electrotyping, etc., depends. Going into animal organism we can readily determine under what circumstances this electrolytic action would seem to be indicated. It is the tendency of acids or the product of electrolysis at the anodal electrode to harden and dry up tissue by the coagulation of the albuminoids that enter into the formation of that tissue. On the other hand it is the tendency of alkalies to soften or liquefy tissue. These are the chemical and the physiological effects of electrolysis when applied to the tissues of the body. Under what pathological conditions may such effects be of therapeutic service?

Anodal Electrolysis: Take, for instance, hyper-vascular tissue, of which the various forms of naevus are typical. What we wish to accomplish in this pathological condition is to constrict the vascularity and lessen the functional activity. How better may we do this than by the coagulation of the albuminoids that enter into the formation of the soft tissues? The surgeon will cauterize a naevus with caustic or remove it by the knife or actual cautery, and so destroy the blood supply, but with a resulting scar that is oftentimes unsightly. Minute needle electrodes serve all the purposes for which these other methods are used but they destroy the arterioles alone by coagulating their contents and leave the remaining parts uninjured. The same principle of application will apply in the treatment of intra-nasal or intra-uterine hemorrhages, and hemorrhages of like nature on surfaces not readily accessible to cumbersome instruments.

These conditions allow of careful localization of treatment limiting the action to the part which needs to be removed, for by using proper electrodes we need not destroy or interfere with the function of adjacent tissue.

Cathodal Electrolysis: If it is the tendency of alkalies to migrate toward the cathode or negative electrode, and if it is the physiological effect of alkalies to bring about liquefaction and induce softening, then cathodal electrolysis is indicated where we have hard, resisting tissue, which is intering with function. Scar tissue is often of this character. It is largely composed of connective tissue in which the interstices are practically obliterated, and in which function is at its minimum. Where this scar tissue occurs as the result of inflammation in any of the ducts or canals of the body or at the site of joints or movable parts, it may interfere materially with normal action and relief is called for. Strictures are typical of the condition that most demands treatment of this character, whether they be of the nasal duct, œsophagus, rectum or urethra. Electrolytic action with the cathode either in the form of needles or sounds, will cause this scar tissue to be softened and thus promote absorption with the re-establishment of better function. It is the work of an amateur if "burning" or destructive electrolysis occurs, and such burning is of course unnecessary and hurtful. Abundant evidence is at hand of the success of cathodal electrolysis in the relief of urethral stricture.

Electric Osmosis or Cataphoresis.—Liquid bodies separated by a porous medium of greater consistency may be moved, by the establishment of an electric current, in either direction. An electric current passed from one to the other of these liquids will tend to carry the liquid at the positive electrode through the intervening substance to the negative electrode, or cathode. This action, which is physical and physiological, may be readily demonstrated, and the pathological conditions that would seem to indicate its employment are auto-suggestive. We have a synovial effusion or a collection in the peritoneum or pleura; we apply the positive or anodal electrode at the nearest point to the affected part and the cathode remotely. The action of the current may not be specific in all cases, but the removal of the fluid through the interstices of the inclosing sac will be materially expedited. This action may, of course, be reversed where a diagnosis seems to indicate the contrary pathological condition. We often require the administration of medicinal agents where it would be extremely advantageous if the administration could be brought about through the skin, and where it is not desirable to use the hypodermic needle. Solutions of the proper agent on a sponge anode at a point on the skin nearest to that desired to be reached, with the cathode remotely attached, is a thoroughly practicable and serviceable method of administration. This treatment may be for constitutional effect or for local stimulation or anasthesia: moreover cataphoric medication is often applicable where we desire to confine the effect to small compass such as in nasal or pharyngeal or uterine cavities.

Physiological action:—This is a phase of electrical application which we may discuss with much definiteness and a good deal of self-congratulation. We know that a large percentage of the soft tissues of the body is made up of contractile tissue, and we know that any one muscle or any set of muscles may be contracted continuously or at intervals, long or short, by the proper application of the electrodes. We have a physiological action here whose offices as a therapeutic agent can hardly be exaggerated. The fact that we can bring about contraction of muscles or sets

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of muscles without calling for energy from the central nervous system, points to its application where we have an injured part temporarily disconnected from its nerve supply, and muscles dependent upon those nerves are in danger of degeneration past recovery from want of use. Here we can keep up the activity of these dependent muscles without disturbing the injured part. Take, for instance, the case of infantile paralysis due to injury in the anterior polar region. These cases are capable of recovery to large extent, but while the slow processes of recovery are going forward there are certain muscles dependent upon the involved centers that are thrown out of use, and whose life processes are impaired and in which degeneration will naturally occur. Unless we can artificially by an electric current keep these muscles in a state of at least partial activity, they are likely to be destroyed or overpowered by the opposing muscles and a deformity will result such as a talipes equinus or a talipes equinovarus. Sometimes we are brought a case in which the muscular degenerative processes have gone beyond recovery; where there is no active contractile tissue. How gratifying it is, if instead of protracting the anxiety and suspense of parents and friends with half promises of recovery, to be disappointed in the end, we are able to make a definite and clear prognosis and save the interested parties worry, time and expense, and let them shape their ends to meet the inevitable. Diagnosis in these cases by electricity permits us to be definite and honest.

The Galvanic Cautery is perhaps the most clearly understood and the most commonly used of all the forms of electricity, and the discussion of it need not be entered into for that reason. Surgeons are using the electric cautery freely and with most excellent effects; sometimes for convenience, sometimes because points for operation can be more readily reached by that form of cautery, and sometimes because it is necessary to use a specific heat, and because it is not possible to preserve always an accurately graded heat by any other method. The fact that the amount of heat in the electrode can be accurately guaged, makes that form of cautery most invaluable under certain conditions; and add to that the ability to confine cautery action within extremely limited space, and further argument seems to be unnecessary.

The Electric Light:—The electric light is used principally, if not entirely in the diagnosis of diseases affecting the nasal fossa, pharynx, larynx, bladder and rectum. The mirrored electrodes with guarded lamps at the end will oftentimes permit a diagnosis that otherwise could not be made. This use of electricity need not have been scheduled under the forms of the direct current, inasmuch as the alternating current has now come into general use for lighting purposes and can be utilized for this purpose as well as the direct.

Induced Currents:—Physicians have for many years made use of induced currents derived from small coils of wire through the forming of which a direct current is passed from one or more battery cells and broken by magnetism induced temporarily in a soft iron bar acting upon a vibrating hammer which is made part of the circuit. These are known as medical induction coils or faradic coils. The current from the forming coil is a direct current but interrupted. The current from the second coil is alternating. Induced currents derived from this source are powerfully stimulating to nerve and muscle tissue and the apparatus is very convenient for securing such effects when they are needed, but the therapeutic uses to which currents of this nature can be put are limited, since they are incapable of producing any marked electrolytic or cataphoric action, and do not furnish sufficient strength to heat cauteries or light lamps.

The Alternating Current from Dynamos:—Some extremely interesting work has recently been done in determining the physiological action of high frequency alternating current electricity. For our purpose we need not follow the experimental steps that have been taken, and we will save time by briefly mentioning results and the deductions that follow. D'Arsonval, of Paris, who is a well-known experimental physiologist and an electro-therapeutist, has done perhaps the most advanced work in this field. After much research he has been able to demonstrate that the alternating current can be employed with such high frequency as to its alternations that contractile tissue will not respond. In other words, he has found that an alternating current of such rapidity can be sent through the body that there will be no apparent effect on contractile tissue, yet he has found that while this high frequency current has no appreciable action on muscular tissue, it has an immense physiological effect. He found that currents of this character vastly increased the elimination of urea and of carbonic acid gas, and increased the consumption of oxygen. Here we have in a nut-shell the effect on the vital function; and this physiological effect being given, it will not be difficult for us to deduce pathological conditions that would seem to call for a treatment of this kind. Take, for instance, the low forms of nutrition such as chronic rheumatism, gout, and the various forms of neurasthenia. Undoubtedly what we wish to accomplish in these cases is a quickening of the nutritive processes, the very things that D'Arsonval has shown that high frequency alternating currents will accomplish. The effect here is produced primarily by a stimulation of protoplasmic evolution or movement. This form of utilization of the alternating electric current has so far had but limited therapeutic use, but it is interesting to touch upon it at this time as an indication of what is being done and what we are likely to accomplish in the near future.

Other experiments are going forward with great promise, to ascertain the effect of the varions forms of electric current upon bacteria. Many pathogenic forms are unable to resist electric action.

Electricity, in the cure of disease has its limitations, and science must develop what these limitations are; to take a part in the useful and interesting work that spreads itself out before us we must be no amateurs. We must be fitted by a certain preliminary training. To use intelligently an electrical current—or to use electricity in any form, the operator must know the conditions under which the electricity has been generated, since electricity is not brought to us labeled as to quantity and quality like the drugs from the modern proprietary pharmacy.

W. J. Herdman

FROM NATURE'S POWER PLANT.

An Electric Rock That Kills All Who Go Near It—Bones of Victims Heaped About.

A grewsome story comes from the Wild West that sounds very like a nightmare--and a wild untamed mare at that. It seems to have had its start in Philadelphia, otherwise some people might question its truth.

About sixty miles north of the Needles, in Arizona, so the account goes, there is a great rock bulging above its surroundings in the mountains, so highly charged with electricity that no animal can go near it without being instantly killed, and the earth about it is piled high up with the bones of its victims—men, and birds and beasts. It not only has the power to kill those who touch it, but also to draw to it any living thing that happens in the neighborhood. During the day time, the rock is of a leaden hue, and it is at that time perfectly harmless, but as night approaches, its color becomes purple, and finally it assumes an incandescence, and glows like fire.

Some hunters who chanced to follow a goat to the neighborhood, saw the goat killed by the electric rock, and afterwards an immense snake that crawled out of a hole in a neighboring cliff was killed in an instant.

Perhaps it was the famous sea serpent, that we used to hear so much about, that the rock killed.

South Haven, Mich., will have a new light plant.

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BOYCE BUILDING LIGHT PLANT.

New Western Electric Installation of Direct Connected Apparatus—Saving of Floor Space—A Material Desideratum.

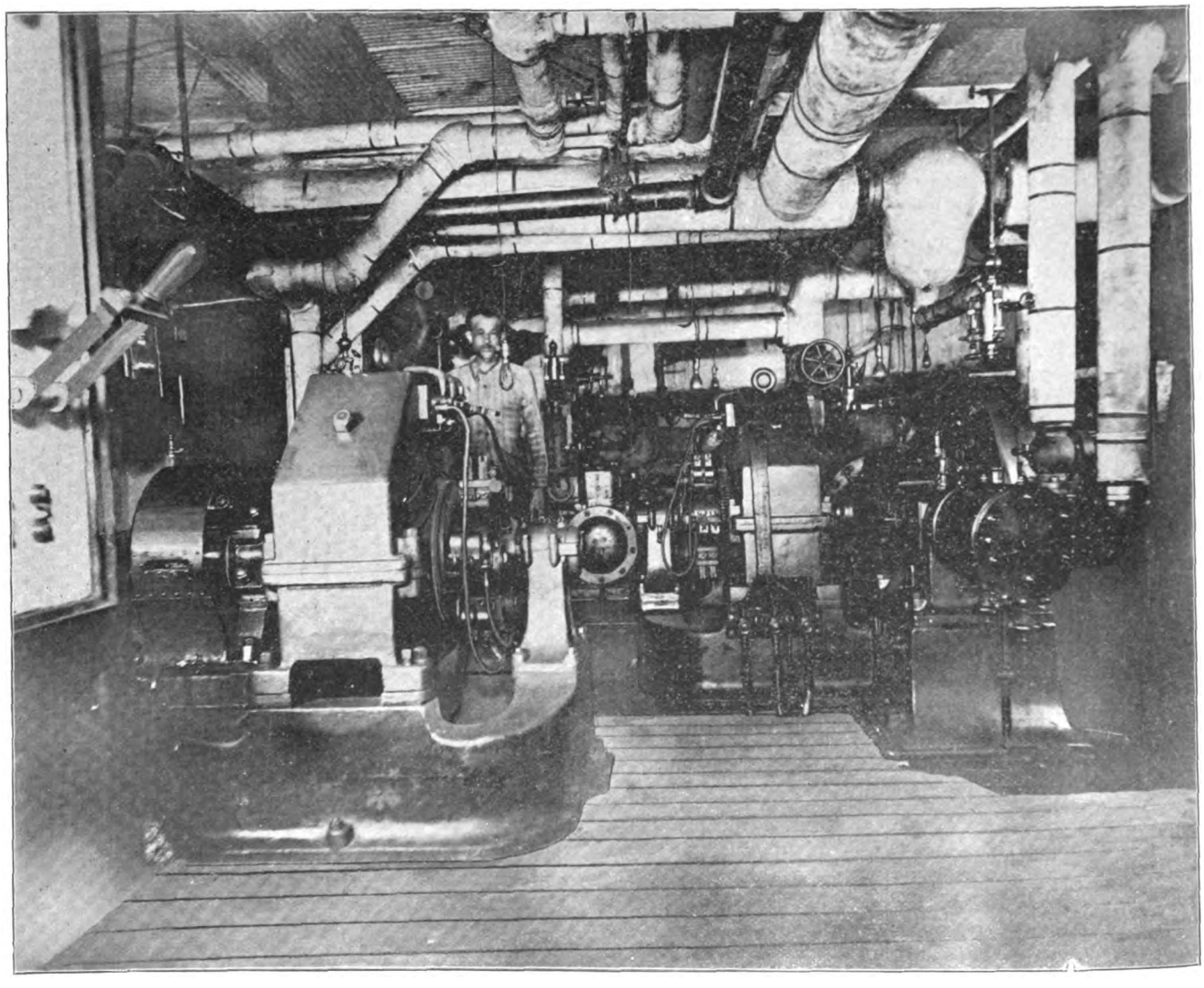
COMPACT, EFFICIENT AND CONVENIENT.

In over-crowded business districts the problem of the economical use of space has become one of paramount importance; the natural result is that engineers in erecting electrical plants for use in large office and mercantile buildings direct their first inquiry to the matter of floor space occupied, and in many cases they are willing to make sacrifice in other respects in order to achieve concentration.

One of the most decisive steps in this direction is shown in the abandonment of the old system of belt transmission, and the substitution therefor of direct transmission through the shaft of the engine. The armature of the dynamo being mounted upon the shaft serves in some degree the purpose of a balance wheel, and it has been found that even at the moderate rotative speeds to which it is necessary to reduce the dynamo in order to accommodate it to the speed of engines as generally constructed, it is possible to construct apparatus fully equaling in commercial efficiency the old high speed designs, and much excelling them in many other important features.

We no longer have the greasy belt with its slipping, its stretching and constant waste of power; we no longer have the rattle and roar of high speed belts, with their disagreeable accompaniment of dust and electrical excitation, nor the exasperating hum of high driven commutators. Instead we have a compact self-contained plant, with less than half the floor space formerly required, and running so steadily and noiselessly as to be hardly perceptible at a distance of a few feet.

As an instructive example of a direct connected plant embodying in a high degree the features which go to make up perfection in design and workmanship, we present herewith an illustration of a plant of direct connected dynamos recently installed in the Boyce building in Chicago. In this plant the entire floor space required for a capacity of 1000 lights, engines included, is less than 100 square feet of floor area.



BOYCE BUILDING LIGHTING PLANT.

The plant is divided into two equal units of 25 K. W. each The object for so doing was two-fold: first, to permit the running of but one unit during such parts of the day as the load was light, and thus secure economical results both in engine and dynamo; second to reduce the liability of a complete shutdown which might occur with a single unit.

The dynamos are of the well-known four pole type manufactured by the Western Electric Company, and are designed with special reference to the duty to be performed, and in this direction one of the first requisites is that the dynamo shall perfectly and automatically adjust itself to the varying conditions

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of load, maintaining the voltage at a practically constant value. To accomplish this it has been found necessary to take into account not only the varying drop in the distributing mains, but the changes in speed of the engines. Even under the most favorable circumstances this variation will commonly exceed three per cent, but so perfectly is this variation adjusted for in the compound winding of the dynamos that practically no regulation of voltage is perceived.

The commutators are of hard bronze with massive segments and large collecting area; large carbon brushes with a wide angle of contact are held in holders, which, while giving perfect freedom of movement to the brushes, provide perfect metallic connection of ample conductivity to the stud.

The armatures are iron clad, of finely laminated iron, and so thoroughly ventilated at all points as to give ready escape for heat.

Field magnet cores are of wrought iron, with the exciting coils wound on bronze bobbins and arranged to be slipped on to the core.

The engines run at a speed of 350 revolutions per minute, and at full load the combined efficiency is 80 per cent, the commercial efficiency of the dynamos at full load being 87 per cent.

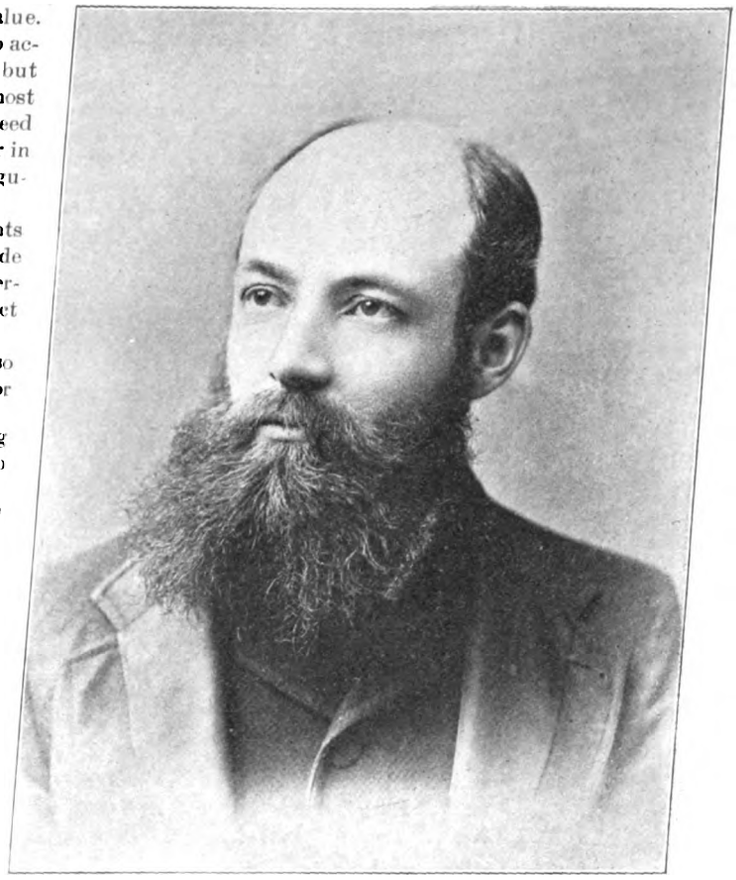
A switch board of white marble, having the necessary main switches, voltmeter, ammeters, rheostats, etc., all of Western Electric manufacture, and so compactly built as to take up but very small space in the dynamo room, completes an equipment that may well serve as a model, and is distinctively a feature indicative of the good judgment, energy and push of the owners of our modern office buildings.

EUROPEAN THEATERS ELECTRICALLY HEATED.

English Playgoers Much Pleased with New Radiators. Heating Plant Installed in Half an Hour.

The English people are likely to be the first to utilize recent American advances in electric heating for public buildings, as will be seen from the following clipping from a London paper:

"Electric heating is becoming the vogue and the strides which have been taken in this application of electricity within the last few months point to the probability that there will soon be but little use for steam in the heating of public and private buildings. There has been such a sudden rush for electric radiators in London that the stocks of the manufacturers have run dry. The story goes that the credit for this intelligent appreciation on the part of the British public belongs to an American theatrical manager in London. It was a cold winter's day; the theater had to be heated by night, and the steam apparatus usually relied upon had gotten out of order. In despair the manager sent to an electrician, who placed a portable electric radiator on each side of the auditorium. The making of a connection with the mains was a simple matter, and in half an hour after the current was turned on the theater was filled with balmy air that, while just of the right temperature, was untainted by the smell of the pipes. The convenience of the arrangement was apparent, as the radiators could easily be moved from one place to another, and slipped entirely out of the way the moment they were not wanted. Their economy was equally beyond question, for they would heat the largest theater for a whole evening for about $3. The audience was delighted, for if there is anything the British playgoer dislikes more than another it is an overheated playhouse, and with the electric radiators the stifling and unwholesome heat so common when steam is used is impossible. The new departure made a hit, and in a few days nearly all the theater and music hall managers in London were considering the advisability of adopting electric heating for their buildings. It does away entirely with any fear of fire near the stage or elsewhere. It maintains a comfortable and even temperature and it requires no attention. There is no furnace to burn out and no rusting or wearing out during periods of disuse, as in the old system; no especial attention is required, and any of the theater attendants can easily operate it.



EDWIN R. WEEKS.

Edwin R. Weeks was born in 1855. He is descended from the Weeks family of New England and the Van Rensselaers of the Hudson. His education was obtained at Tabor College and Phillips Exeter, New Hampshire.

In 1882, he became identified with the electric light interests in Kansas City, as the first superintendent of the first Thomson-Houston station in the world. He has since had continuous charge of the Kansas City Company whose plant now comprises several hundred horsepower in stationary motors, fifteen hundred arc, and sixteen thousand incandescent lamps. Mr. Weeks is a member of the executive board of the Association of Edison Illuminating Companies, and past president of the National Electric Light Association.

He is also a member of the American Institute of Electrical Engineers, of the American Academy of Political and Social Science, and of the Civil Service Reform Association, and, in his own city, is president of the Humane Society.

A considerable part of his literary work consists of papers on Astronomical and electrical subjects, notably on electrical education and plans for societies to promote the welfare and improve the efficiency of electrical employes. He is greatly interested in the cause of education, being an earnest advocate of the Kindergarten and manual training in the public schools.

PENN'S STATUTE TO REVOLVE.

The great statue of the founder of "brotherly love," which surmounts the dome of the city hall in Philadelphia, stands facing the old Penn Treaty Park. Much dissatisfaction has been caused and great discontent on the part of residents of the southern and western parts of the city on whom William has his back turned. A proposition is now on foot to have the statue revolve so that at some time within the twenty four hours it will face all points of the compass. This unique plan is the suggestion of J. Chester Wilson the well known engineer. The clock work machinery which it is proposed to use will be operated by electricity, and if the plan goes through the statue will be illuminated by hidden incandescent lamps, and marks will be placed on the pedestal, so that the shadow of the statue will indicate the time of day.

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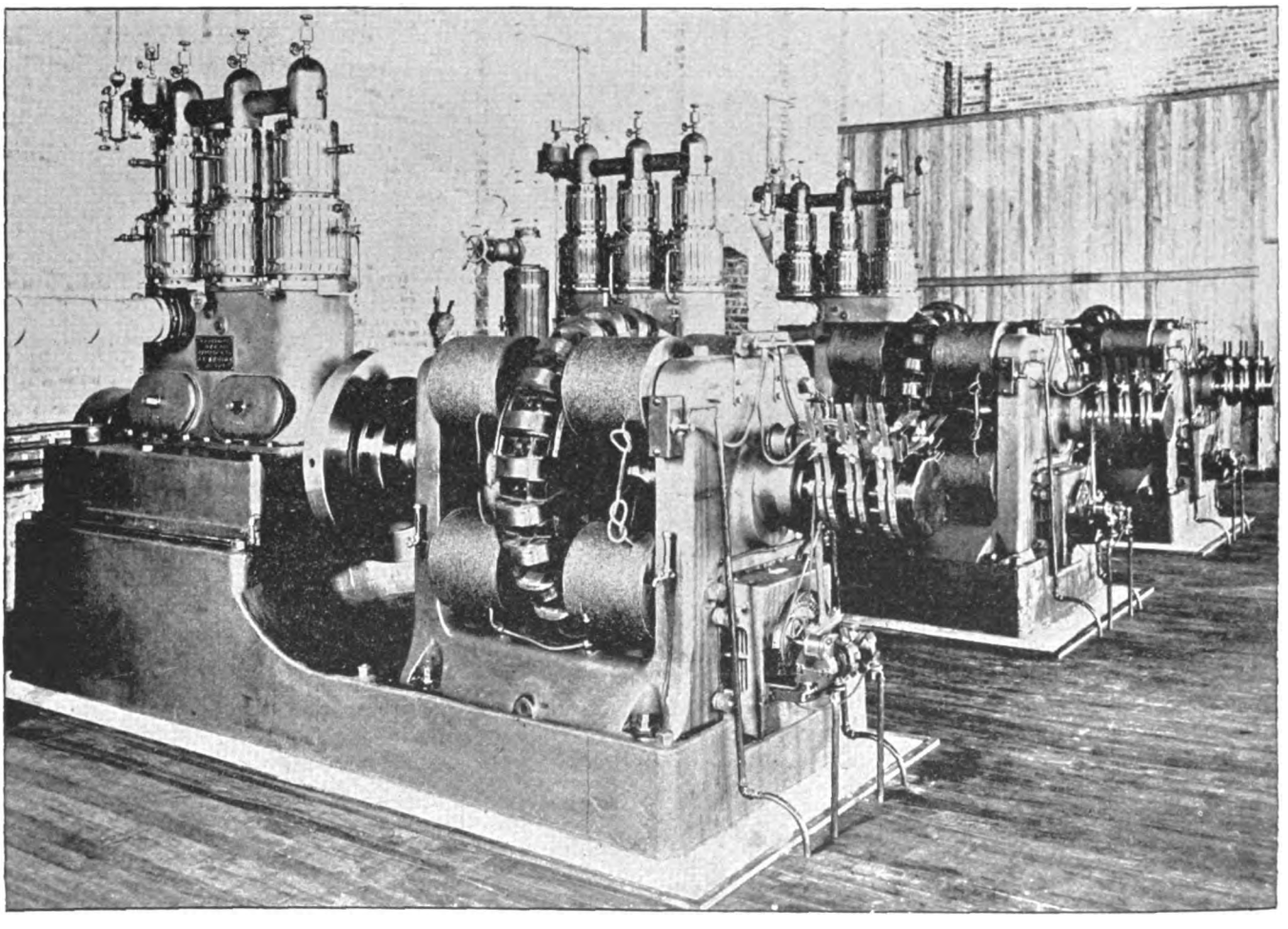
NEW RECORD BREAKING PLANT.

Directed Connected Arc Station of the Mutual Electric Light and Power Company Showing unusually High Efficiency.

BRUSH MACHINES DOING SOME GREAT WORK.

The new station of the Mutual Electric Light and Power Company, at Brainard, in the Southern part of Chicago, has been in operation since the first of the year. Some card readings and efficiency tests just completed, give a record that promises to set a pace for lighting station managers and machinery builders for some time to come.



INTERIOR VIEW MUTUAL ELECTRIC LIGHT AND POWER COMPANY'S PLANT.

The plant includes three Brush dynamos of 150 lamps capacity each, directly connected to three central valve high speed Willans engines, made by the C. M. Bullock Manufacturing Company of Chicago. Two 300 horse power Standard Boilers made by the Link Belt Manufacturing Company of Chicago, supply the steam for the plant.

As shown in the illustration, the engines are three line, double expansion, with no valve gearing in sight. The piston rods are hollow and within them are the valves that govern the passage of the steam from the steam chest which is mounted above the high pressure cylinder to the upper side of the high pressure piston; from there to the lower side of the same piston, then to the upper side of the low pressure piston and from there to the exhaust chamber below the low pressure piston. To obtain the indicated horse power of one of these engines it is therefore necessary to take three cards from each set of pistons or nine cards in all. One set of these cards as taken from the dynamo end of one of the engines is shown below. The boiler pressure at the time the cards were taken was 175 lbs.; speed, 487 revolutions; length of stroke, 6 inches; diameter of low pressure piston 12 inches. Card A is for the primary cylinder above the piston, card B for the primary cylinder below the piston and card C for the secondary cylinder above the piston. A 120 pound spring was used on the indicator for card A and a 50 pound spring for cards B and C. The upper straight line of card B indicates the same pressure as the lower edge of card A and B may therefore be considered as an extention of A, proper allowance being made for the difference in the springs. The work done by this set of cylinders is therefore equal to the sum of horse powers indicated by the three cards, and the indicated horse power of the whole engine would be the sum of the horse powers of the three sets of cylinders as shown by the 9 indicator cards.

In this particular case the I. H. P. was 105, the load on the dynamo 9.6 ampheres and 6,350 volts. The number of lamps burning was 127 and the length of the circuit 10 miles. The electrical output expressed in horse power was 81.72. This would give a combined efficiency (electrical horse power divided into indicated horse power) of 77.8 per cent. which for an arc lighting plant is exceptionally high.

The steam is exhausted through a 1,000 H. P. Excelsior feed water heater. Water is supplied to the boiler at a temperature of from 205 to 210 degrees: 20.5 pounds of water and 3.1 pounds of Indiana nut coal are used per horse power hour. The consumption of oil for each engine is so small as to be nearly negligable. The crank pins dip into oil and water each revolution, while the other parts are oiled from oil cups in the ordinary manner. One half pint of castor oil and six quarts of water

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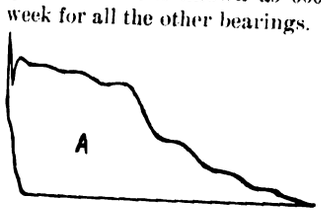
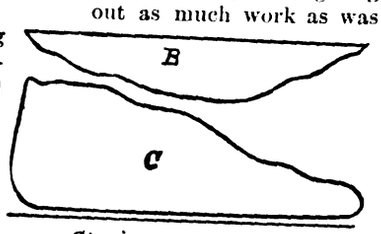
are used each week on the average for the crank pins and six quarts of what is known as 600 W Vacuum oil is used each week for all the other bearings.



Spring 120lb.

In order to prevent the engines pounding, a round guide piston is mounted on piston rod below the low pressure piston, which works in an air tight cylinder. Air is compressed in this cylinder on the up stroke and on the down stroke it expands, giving out as much work as was consumed in compressing it. These engines are governed by a centrifugal spring governor and throttle valve. The only stuffing box on the whole engine is around this valve stem which is about ⅜ inch diameter.



Spring 50 lb.

It seems especially fit that the original manufacturers of arc lighting apparatus in this country should also be the first to install a direct connected arc lighting plant.

The Brush dynamos are of great interest from the fact that their capacity is higher than that of any arc machines built, and that their speed is exceptionally low compared with their size and capacity. The first of these dynamos was started without a hitch on Dec 17, 1894, and within fifteen minutes after steam was turned on, the entire load of 125 lamps was thrown on and this full load was carried the balance of the evening. The automatic regulator of the dynamo regulates so closely that any number of lamps may be thrown on or off at will, the brushes being automatically shifted while at the same time the current is shunted in the fields, thus providing absolutely perfect regulation. The electric plant was installed by Mr. J. B. McKeown, of the Brush Electric Company.

The entire plant from beginning to end embodies the best machinery and the best construction possible, and is in every way a model of neatness, efficiency and perfection.

The officers of the Mutual Electric Light and Power Company are making great effort to improve present commercial methods and unless signs fail, their work will greatly benefit station men all over the country. The officers are as follows, the offices being 1208 Fort Dearborn Building, Chicago: E L. Brainard, Pres.; A. D. Rich, Treas.; W. A. Conover, Secy.; A. R. Heckman, Manager, and Arthur Thurlby, Superintendent.

LAKE STREET "L" ROAD TO USE ELECTRICITY.

Yerkes' Plant Will Supply the Power—System in Operation on the Metropolitan is Selected.

The Lake Street Elevated Road in Chicago will change its motive power to electricity. Contracts have been closed between that road and the Yerkes West Side Electric System for furnishing the power. The system will be that used on the Metropolitan, which means that the World's Fair Intramural is to be the coming method. Fortunately, the road was originally built heavy enough to carry any sized cars, or trains, so the expense of the change will include only the abandonment of the present steam locomotives, the purchase of electric locomotives, and making the necessary connections.

The Northwestern road when finished will also use electricity. When there is a down-town loop for all the roads, the Alley "L," will be the only one that will be inconvenienced by the absence of electric connections, and it is said that the City Council will prohibit the use of steam farther into town than the present terminus at Congress street. Such action will convert the road into an electric system.

FAMILY OF HUMAN MAGNETS.

A strange and interesting story comes from the upper Yakima and is going the rounds of the press at present. Two years ago Peter Stromstadt located on a piece of land near what is now known as Barox Springs, his family consisting of his wife and two children. A few days after his settlement Mr. Stromstadt discovered a spring close to the shack he had erected, the water of which was strongly impregnated with iron, but not unpalatable. Mr. Stromstadt dug out and deepened the spring, and since July, 1893, the family have used the water for all domestic purposes. On the night of April 2d a heavy electrical storm passed over the Cascades, accompanied by vivid displays of lightning. The following morning Mrs. Stromsfadt, while kindling the fire in the stove, found it almost impossible to separate the stove lifter from her hand. Her husband, hearing her scream, ran to her assistance, when, to his surprise, he found that he, too, experienced great difficulty in detaching any article of iron with which his hands came in contact. Breakfast was finally prepared and the family sat down to the meal. The children, two girls of five and seven years, drank their milk from tin cups, and upon raising the cups to their lips found themselves unable to detach the cups from their mouths. Mr. Stromstadt, who is an intelligent immigrant from Sweden was nonplused, and, while unable to account for the wonderful occurrences, nevertheless laughed at his wife's excited declarations that the family were bewitched. Mr. Stromstadt has written a friend in town. He says that the small bed on which the children sleep is upon roller casters, and that in the morning the bed is invariably pointing north and south, the bed being a little to the east of north. The case is one of the most remarkable on record. A member of the Academy of Sciences, to whom the circumstances were related, states that the Stromstadt family have become saturated with iron, which was rendered magnetic by the passage of electricity from the clouds to the earth during the storm on the night of April 2d, and they are actual human magnets.

MEMORIAL TO THE CABLE BUILDERS.

A large historical painting has just been hung in the Chamber of Commerce of New York commemorative of the laying of the first Atlantic cable in 1866.

The picture represents a meeting of the cable projectors at the residence of the late Cyrus Field. Peter Cooper is presiding, and Mr. Field is pointing out on a map the proper landing for the Cable. David Dudley Field is standing near the president with a law book. Chandler White is handing estimates of expense to Marshall O. Roberts, and near them at the table are Moses Taylor and Wilson G. Hunt. Samuel F. B. Morse and Mr. Huntington, who is engaged in sketching, complete the group.

Chauncey M. Depew the orator on the occasion of the presentation commenced his address by saying:

"The picture which is hung today upon the walls of the Chamber of Commerce illustrates one of the great events of history. The men who are portrayed in it are representative of American pluck and opportunity. Each of them in his own way did much for the commercial supremacy of the metropolis and the grandeur of the commerce of our country. They were, in the broadest and best sense, self-made men. They were not accidents, but architects. All commenced life without fortune or influence, with no other capital than character and brains, and coining power, fame and fortune."

The canvas is 7x9 feet, and cost $20,000 exclusive of the massive gilt frame which cost $500 more.

An electrical journal in the Japanese language is being published in Tokio. Its illustrations have the long drawn perspective of the East, yet it seems to be up to date in other respects, if one can judge from the "ads" of well established companies in its pages.

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THE ELECTRICAL JOURNAL

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(1st and 15th of each Month)

...BY...

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

VOL I. CHICAGO, JUNE 1, 1895. NO. 1.

Salutatory.

Modestly, yet confidently THE ELECTRICAL JOURNAL makes its bow in the arena of journalism.

It does not assume to fill a "long felt want."

It concedes cheerfully and with pride, that electrical interests are in able hands.

It does not aspire to a leadership in scientific thought, nor has it the lofty ambition to excel its splendidly equipped contemporaries.

It believes however, that the field of electricity in science and commerce, in art and the industries is a rapidly broadening one, and it believes that the forces at its command if properly directed, can be made material factors in the achievements of the future.

Recent experience of its management in closely kindred work, has demonstrated the existence of a very large class of people in this country interested in electricity—commercially or otherwise, the members of which are practically debarred from a knowledge of electrical principles and laws, owing to the deeply scientific and mathematical character of existing text books and current literature.

It is to be the aim of THE ELECTRICAL JOURNAL to keep the members of this class thoroughly posted on electrical matters, and to present for their information and entertainment, items and discourses on every conceivable electrical subject.

It may fairly promise to be among other things, honest, earnest and accurate in all its statements and dealings, and to treat all subjects in clear, concise everyday language comprehensive to the ordinary newspaper reader.

It is with much pleasure and no little pride that THE ELECTRICAL JOURNAL is able to announce the conclusion of arrangements which will place its editorial and news columns under the direction of men known to be in full sympathy with the principles which it has announced.

This staff will be found elsewhere in this number.

It is believed to be desirable that not only special articles but also important editorials shall be signed by their authors, hence a feature of this paper will be editorial utterances dignified by the signatures of the writers in order that readers may be able to place a proper value on, and give proper weight to them.

THE ELECTRICAL JOURNAL begins its career with a large number of friends and well wishers, and its highest ambition will be to realize their estimate of a live, bright, thoroughly up to date newspaper, devoted to the interests of electricity- in all its branches and especially as these effect non professional people.

* * *

There will soon be business enough to go all the way round, but you must be in the circuit to get a shock.

It is rumored that the Columbian awards are to be distributed by special delivery. The regular mails are too slow.

Electrical interests were the first to feel the hard times. The circle has been completed and good times are at hand.

We are for gold all the time, but silver will not be refused for subscriptions to THE ELECTRICAL JOURNAL. We are willing to conciliate both parties.

Now that gold is at a premium, we may be able to use a little of our surplus silver in patching up our orators' tongues. Silver tongued orators went out of fashion when silver came into favor.

About the only commodity that the stock jobbers have not cornered this spring is electricity. The fact is mentioned merely as a suggestion to those bulls and bears who like things lively and active.

Charles A. Chase, an inventor of Chicago, is chasing after fame and fortune in the sunny fields of applied electricity. He claims to have a device which discounts the Kinetoscope. The question is—kin it scoop the Kinetoscope.

Inventors of conduit trolley systems seem to be developing rare traits as newspaper advertisers, seemingly to the neglect of the more serious and certainly more necessary business of building roads to demonstrate the feasibility of their plans.

Some of us are never so happy as when we have something to be perfectly miserable about. Street railway managers are deploring the advent of the bicycle as it decreases their custom. They have not removed the "hold fast" straps in the cars, however.

The electrically heated carriage may be all right but there is a lurking danger that if it should come into common use, the time honored duty of holding a pretty hand to keep it warm—the prettier the hand the greater the duty—may no longer exist, and if we are to go farther still and light the carriages with incandescent lamps but why discuss a prospect that has no earthly chance of fulfillment. The rising generation, male and female is against any such innovation. It would be sacrilege.

It is an ill wind that affords no one a breeze. Before the hard times came, the electrical business was driven at a killing pace. Hence its wind gave out. The past two years have been a revelation. We have learned economy. We have learned to put business men at the head of business affairs and to keep inventors in the work shops. We have learned closer business methods than we ever before had occasion to practice.

It was a hard lesson, but it is that kind that we value the most, and that we remember the longest.

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Economy in Arc Lighting.

The development in the technics of series arc lighting for the past ten years has been very slow. This may perhaps be accounted for by the fact that the business has been for the most part in the hands of two great companies, who have left what appeared to be well enough alone.

The most recent distinct advances are the increase in the number of closed-coil Gramme ring dynamos, the improvement in arc lamps, and the introduction of much larger machines. It may be disputed that the first is an improvement, but it cannot be denied that it is a decided advance over the earlier practice. Hundred-light machines, of both the open coil and the closed coil types, appear now to be giving satisfactory service.

Another definite advance, involving higher economy and more satisfactory service, is needed and the direction in which it can be accomplished has already been pointed out. The requirements of arc lamps on constant potential circuits have compelled improvements in carbons; and it is difficult to account for the slowness of station managers in adopting them. The higher price of a good quality of cored carbons has undoubtedly had the effect of deferring their general adoption. But first cost is by no means the only consideration. If cored carbons will furnish more light for the same power expended on the lamp, or the same light for less power, the question resolves itself into the relative cost of the carbons and of the power or fuel which they will save. Now extensive comparisons of arc lamps with cored carbons and with the common carbons of commerce, in the photometric room, have demonstrated to the writer that the former, if of the best quality, give ten per cent. more light than the latter for the same number of watts expended on the lamp, or if supplied with ten per cent less watts, give the same candle power. The employment of these carbons will then be determined in part by the cost of power; but the fact should not be lost sight of that good cored carbons furnish a light of superior color and steadiness.

Another consideration entering into this question is the increase in lamp capacity, which a machine gains when the lamps are trimmed with cored carbons of first quality. It is not uncommon to find arc machines overloaded, with unsatisfactory lights as the result. A diminution of ten per cent. in the volts required by each lamp would in such cases afford a decided relief. The best cored carbons appear to require a difference of potential not exceeding forty volts for their most satisfactory operation. This is certainly ten per cent. less than the requirements of common carbons to prevent hissing. Since the current is no larger, the cored carbon insures economy of power and an increased capacity of the arc light dynamo.

Henry S. Carhart

* * *

The Medical Profession And Electric Science.

The time was when the members of the medical profession were the pioneers and leaders in all lines of research that had for their object the explanation of natural phenomena. The human body in health or disease is a theater for the play of all the natural forces. No one of these forces is excluded from a share in the more or less intricate processes of absorption, nutrition, excretion, etc., which are continually going on in the living animal organism. Mechanical and chemical energy, light, heat, sound and electricity all enter into the problems with which the physician has to deal when considering the normal or abnormal activities which the human organism exhibits. It was but natural therefore that in his attempt to peer deeply into and understand the workings of that complexity of forces as they operate to produce the phenomena of life in man's physical nature, the physician was led to occupy himself with the action of these same forces outside the human organism. He became the originator, the promoter and the patron of scientific research and much that modern progress has achieved in revealing and utilizing the capacity of these forces in nature can be traced back to its source in the modest discoveries and suggestions of some thoughtful philosopher whose daily round of duties were those of the healing art.

To no class of our readers, therefore, ought the discoveries in electricity and magnetism to be more attractive and interesting than to the physician. He has a field peculiary his own in which to study the laws which govern electric action and it is found that these laws, as they have been revealed by the study of electricity in inanimate things, hold true when applied to animate things.

What the relationship of electricity is to physiological processes and what part it takes in the modification of these processes when they become pathological is a fruitful field for research, and is one which ought to attract many more investigators of an entirely scientific turn of mind than are now occupied in it. The art of medicine and surgery has already found in electricity a potent and docile handmaid provided he who employes it will patiently set himself about learning to know and appreciate its capacities; for its best service is not rendered to those who wilfully or in ignorance depreciate its virtues. It is our purpose in the columns of this Journal to furnish an arena wherein those members of the medical profession who have kept pace with the advancement of knowledge of electricity may champion the views they entertain regarding its phenomena and action against all comers whether their data be derived from its operation in the organic or inorganic world, and we hope from the friendly discussions thus provoked to bring to light much that is already known in a corner, but is worthy of being proclaimed from the housetop.

W. J. Herdman

* * *

Street Car Accidents.

The rapidity with which electricity is being adopted for street railway service all over the country is the best possible evidence that it affords a more satisfactory means of transportation than either the old horse car or the cable. But there is a feature about the operation of the roads that is causing a great deal of complaint and in some sections has given rise to an open war upon the companies; that is the appalling number of accidents that occur on many lines. Brooklyn seems to be particularly unfortunate in this respect, and recently a mass meeting attended by nearly 5000 people was held there to enter a protest against what they termed the "incorporated manslayers." With a death record of 110 on a single railway system within an astonishingly short period, it is not to be wondered at that some action was agitated to put a stop to it. But why this wholesale slaughter? It is entirely unnecessary and the remedy lies right in the hands of the aggrieved community. The people want rapid transit but they do not want express trains run through their crowded thoroughfares, and if they permit surface roads to run pell mell regardless of the congested condition of the street they must expect and certainly will realize the fruits of it. The remedy is easily applied. There are outlying districts in every city where a high rate of speed can be maintained. There are others where it is not safe to run over ten miles an hour, and in the more crowded districts it may not be safe to proceed at a faster speed than say seven or eight miles. Let city authorities determine these rates of speed and then enforce an observance of their ordinances. It is no more difficult to regulate the speed of electric cars than cable cars. Electric cars can be controlled to a nicety, then why not do it. A policeman would immediately arrest a man for driving a horse at a too rapid speed through the streets, why not arrest and punish motormen for the same offense. If an ordinary fine will not teach them to respect the ordinances, then impose an extraordinary fine; it will soon have

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a salutary effect. The system of propelling cars by electricity is not to blame, it is the abuse of that system.

Accidents will of course happen occasionally. Sometimes these accidents will happen owing to the carelessness of the public, sometimes it will be due to the carelessness of the motorman, but that does not show the system to be at fault; people sometimes choke to death while eating, but no one would advocate that eating should be discontinued on that account. Horse cars sometimes kill people, cable cars do quite frequently. Let the electric roads put intelligent, responsible men in charge of their cars, let the public use due caution in crossing thoroughfares and in getting on and off cars. Control the speed by ordinance and enforce an observance of the law, and then when accidents happen as they sometimes will, place the responsibility where it belongs and if it is with the motormen hold them and the company by whom they are employed to a strict accountability. If these precautions are taken and the policy as outlined is pursued there will be fewer accidents and less cause for complaint. It should not be forgotten by press or people that points of perfection in systems of street railways, are lightness of cars, noiselessness, and the ability to start and stop quickly and to cover ground rapidly. The people demand all these things and car and motor builders are only catering to public necessity when they compete with each other in reaching the maximum of these perfections. They are all elements of danger however, and safe guards are necessary. Moreover, it must not be thought that the electrical people are interested, nor must they be in warding off blame from railway companies or their employes when accidents occur.

The future of electric street railway traction depends on its safty to the public. All other points are already decided in its favor.

* * *

The Telephone Situation.

While the war wages fast and furious in the telephone arena, let us not forget that about the only electrical patents that have been defended to the last ditch, are those owned by The American Bell Telephone Company, and to that extent the Bell people are entitled to the respect and consideration of the whole electrical fraternity.

It is the almost unanimous judgement of the courts that the purchaser of an electrical patent becomes the owner in fee of a first class law suit, and incidentally these judgements are and have been a commentary upon patent office methods. If the legal profession and invention pirates have any respect whatever for bona fide owners of American patents, the lesson which has created that respect has been taught by the American Bell Telephone Company.

At the beginning of its career the company fought for what it claimed as its rights, and however much we may differ as to the merits of the award in the original case, we can not but admire the brilliant and aggressive administration of the Company's affairs. If the owners of all other electrical patents had insisted on their rights to the same extent the patent office people would have been more careful in handling applications, and there would not be today among the public at large and especially in the realm of capital, that feeling of insecurity as to the value of electrical property that exists at the present time.

No one thing has so greatly embarrassed the electrical business in its earlier struggles as the facility with which the courts have ridden over the rights of electrical inventors and the purchasers of their patents.

* * *

Subscribers who contemplate preserving THE ELECTRICAL JOURNAL with a view to binding the copies by volumes will be interested in knowing that at the end of each six months a properly classified index will be issued covering the subject matter of the different numbers.

Cable Will Be British.

John Bull never fails to take advantage of any opportunity which will strengthen either his political or commercial relations with the outside world. While Uncle Sam contented himself with making a treaty with Hawaii providing against the possibility of foreign powers obtaining possession of Hawaiian territory, the inhabitants of the "Tight little Island" have arranged for cable connection with all landing places on British soil—and will proceed to monopolize trade that according to all natural laws ought to belong to the United States. The pinkertonian motto "we never sleep" seems to be the rule of action which governs the Britisher while too often for the good of American interests our own government resembles too closely our ancient friend "Rip Van Winkle." The United States should by all means have had that cable connection with Hawaii.

The following clipping from an Ontario paper speaks for itself:

"It may be taken as a settled fact that the Pacific cable will be, like its promoters, essentially British. Under its treaty with the United States the Hawaiian government is precluded from allowing any foreign power to acquire any portion of Hawaiian territory. The United States having given an adverse answer to Great Britain's proposition to secure Necker or Bird Island as a cable station, the Fanning Island route will therefore be adopted. The link from Victoria to Fanning Island is 800 miles longer than to Necker Island, but this, it appears, will not militate against the effectiveness of the cable. All tenders for construction have been given assurances to this effect. Fanning Island is a British possession, so that all the landing places of the cable will be within the empire."

* * *

No Ear For Music.

The last time Patti was in St. Louis, the residents gave her such poor patronage, and so openly criticised her singing, that she swore a great swear never to return there again, and she never has done so. Emboldend by their signal success with the great singer, the people have now turned the vials of their wrath against the electric lights of their city. A monster petition has been circulated and numerously signed protesting against the singing of the arc lights on Locust Street in the neighborhood of Jefferson Avenue. The petition, which is directed to Prof. A. J. O'Reilly, City Electrician, cites the fact that no arc lamps can sing well, and that some "New fangled ones" recently put up have no music at all in their voices, and that instead helping them to sleep and thus add to the reputation of the town, the inharmony of their music actually serves to keep people awake. The St. Louis papers commenting on the critical condition of things say that the demand for voiceless arc lamps is formal and imperative.

* * *

Importance of the Telegraph.

The telegraph and telephone are accepted now-a-days so much as an integral part of our civilization, that we can scarcely realize what it would mean if we were compelled to do without them. During the Hawaiian imbroglio a year ago, the fact that those islands had no telegraphic communication with the rest of the world was brought forcibly to our minds. There were days during which we had no news, and a new government had been set up and an old cast down for a week before we were aware of the change. It is not improbable that the presence or absence of telegraphic communication with the United States may determine the fate of the Islands. If Great Britain builds a cable between Canada and the Islands as she threatens and has already started to do, it will be a very strong tow line by which to pull Hawaii into the net that "the sun never sets on." Meanwhile the British press praises Mr. Cleveland's brilliant foreign policy.

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Our Portrait Gallery.

Accompanying this issue, on fine enameled plate sheet is a well executed copper plate etching of the "Layers of the First Atlantic Cable." This is the first of a series of etchings that will be issued by THE ELECTRICAL JOURNAL. Each number will contain one, and the series will embrace portraits of those who either by their inventive genius or by some other distinguishing characteristic have won for themselves a place in the front ranks ofelectrical knowledge and progress.

It is proposed to make this special plate series a feature of THE ELECTRICAL JOURNAL, in the execution of which it will take great pride. The portraits, carefully preserved or framed, will make a collection of great interest, and one not easily obtainable.

From time to time other special features will be added, the purpose being to make THE ELECTRICAL JOURNAL a most welcome comer in every home, factory and business house.

* * *

Electric Heating And Cooking.

One of the most profitable and promising fields in electricity today, is in heating and cooking. In another column is an account of the adoption in England, of the American system of heating for theatres. In large cities like New York and Chicago, where apartment buildings are fashionable, and where gas ranges, stoves and steam heating apparatus are the *bete noir* of the house keeper's existence, there ought to be a splendid chance for the new, clean and convenient appliances for cooking and heating. There seems to be no doubt that on the score of economy, electricity can compete with gas and coal—at least when the elements of cleanliness and convenience are taken into account, and about all that is needed now is some good hard work on the part of those in the business.

The time for patent controversies and financial disputes is past or ought to be, and the real work of making and selling apparatus should begin.

* * *

New Orleans Street Car Muddle.

There seems to be a promise of settlement of the differences between the Louisiana Electric Light Company and the New Orleans Traction Company, concerning the contention of the one that it is the fault of the other that cars are often stopped at inconvenient times and places. Manager Cable of the Light Company states that the trouble arises from the fact that his Company agreed to furnish power for a certain number of cars and that the Traction Company has added greatly to the number without making adequate arrangement for more power. This seems to be a plausible reason for the difficulty, and its truth or falsity aught to be an easy matter to determine.

There is no doubt that a solution would be for the Traction Company to put in its own plant, especially if its business is so large that irregularities in service can make as much of a stir in the city as seems to be the case.

* * *

Brooklyn Means Business.

The Brooklyn people have gone to work in the right way to decrease the number of accidents on the trolley lines in that city. They have demanded an ordinance lowering the rate of speed within the thickly populated districts, and they have also begun to hold the proper parties responsible for those that have a ready occurred. Under the New York law, corporations may be indicted by the grand jury and punished by very heavy fines. As soon as the companies and their officers are held to an accountability instead of irresponsible motormen, there will be drastic measures taken to rectify existing evils. The sooner this child killing business is stopped, the better it will be for electric traction.

* * *

Philadelphia has a record of 103 victims of the trolley car within the past seventeen months.

Our Friends Contribute.

While the decision (the Berliner) of last week complicates the situation, it does not appear to narrow the telephonic field of opportunity in any essential particular. *-Electrical Engineer.*

Another effect which the decision will have, will be to make more generally known the fact that other transmitters than those based on the Berliner patent are equally as good, if not better. As stated in our last issue, the Bell Company have so industriously given currency to the idea that the microphone was essential to the art of telephony, that the public has been led to believe that it was true.—*Electricity.*

Wall street enjoyed another week of prosperity. There was less London buying than during the preceding week, and much more domestic interest in the market. Trade reports are quite generally favorable, reflecting a further expansion of business nd rising prices. Important advances in wages in the iron and steel trade are regarded as a very important indication that the improvement has come to stay.—*Electrical Review.*

The reversal by the United States Circuit Court of Appeals at Boston last Saturday of Judge Carpenter's decision annuling the Berliner telephone patent, adds another to the legal sensations that have been so plentiful the last several years in connection with electrical patent litigation. That the action of the Circuit Court of Appeals involved a miscarriage of justice will, we believe, be the verdict of the general public, and there is much apparent reason to sustain this view.—*Electrical World.*

It is difficult to see how a company could pay dividends while producing but 30 watts from a pound of coal, unless some accomodating neighbor furnished the coal, put it in the boilers and carried away the ashes Economy is to be produced not by the installation of the most modern high class apparatus but in the operation of the plant, the control of the load and the efforts made by the management of the company to secure customers or means for using the surplus power during the period of light loads.—*Electrical Industries.*

The advocates of municipal control of semi-public enterprises will find something to reflect upon in the report that the Japanese Diet has been petitioned to transfer the telephone service in that country from state to private control. No reason is given for this action, but it is presumed that the state management of the telephone is not up to the Japanese ideal. Quite a picture—municipal control running riot in America, while in Japan, where the state has been everything, they are yearning for some private enterprise.—*Electrical Age.*

To all disinterested foreigners who have investigated the subject the desirability and utility of cable connection between Hawaii and the United States are very apparent. Thus Prince Francis Joseph of Battenberg, who is just completing a tour around the world, recently spoke of the Hawaiian Islands in most enthusiastic terms to a New York reporter. "They are the most charming of the South Sea Islands," he declared, "and I cannot help believing that there is a great future before them. But it must be under American protection with a local government, and I should think there must be a cable between the islands and San Francisco—the sooner the better. Ten days' time between the two countries is too long, and all your commercial interests demand the speedy establishment of telegraphic communication." The opinion of the prince is shared by most Americans, but it doesn't find much favor with the present administration at Washington.—*Western Electrician.*

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The longest distance which an electric wire has been carried without support, is a mile and a half. Between Quinten and Murg, two Alpine towns of Switzerland, a telephone wire is stretched across Lake Wallen. It is about one-twelfth of an inch in diameter, and is kept taut and yet given enough play to prevent breaking by means of weights carried on pulleys.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students.

Personal and Pertinent.

There is a well defined belief among non electrical people that the science of electricity is shrouded in mystery, and that only those who are specially favored in some accult way can be admitted within the sacred precincts.

This belief is undoubtedly due, in a measure to the fact that the higher mathematics play an important part in calculations and in figuring the results of experiments. But it is also due to the apparently marvelous and the certainly striking manifestations capable of production with scientific apparatus.

If there were no commercial side to electricity this condition would meet with consideration, and scientists could proceed with as little regard for popular favor and appreciation as that shown by the great astronomer or the biologist.

But if electricity is to enter into the various commercial fields and exert an influence on other sciences and industries, more people must be taught its principles, so that they can apply it in their own business. There is great need of electricity in medicine. The mechanic will evolve much better machinery if he knows what electricity with do under given conditions. The lawyer cannot properly defend the interests of electrical inventors and patentees unless he is familiar with at least the elementary principles of the science. The expert worker in any branch of electricity will be a far more valuable man to his employer hence capable of earning more money for himself if he knows enough of the principles of electricity to apply the science in improving work and in evolving new methods and desiguing new things. The manufacturer who knows something about electricity will be able to improve his output by the addition of an electrical department if only, he knows enough about the science to determine the directions in which it can be made to serve him. In fact there is no class of business people that would not be benefitted by a knowledge of electricity, and electrical interests of every character will be served by the advent of these people and the connections they will bring with them.

But the great question comes up, how are they to acquire the knowledge which we insist, and which they know would be so salutary for them? They have not the time to go to college, and could not pass the entrance examinations if they had the time. They have forgotten or never knew mathematics to the extent that would enable them to follow the standard text-books and current electrical literature.

The National School of Electricity is organized and operating to supply this much needed service, and THE ELECTRICAL JOURNAL proposes to hold up its end by supplying its students and all students of electricity with a knowledge of what is going on around them in languago that the ordinary news paper reader can understand. It is no criticism of ones intellect to put things plainly, nor is it a reflection on ones intelligence to assume that he would prefer his reading in the simplest possible form.

The Portland, Oregon classes have been granted the use of the public school buildings in which to conduct their work.

That feature of THE ELECTRICAL JOURNAL appertaining to the use of electricity by the medical profession, will be an innovation, both in medicine and in journalism.

Professor W. J. Herdman of the honorary faculty last week addressed the Chicago electro therapeutic classes of 150 physicians, on the subject of the "Lethal Effects of Electricity."

The instructor for the Elkhart class makes the trip from Chicago every week, a distance of 101 miles.

Members of the honorary faculty and instructors have been in conference during the past two weeks with a view to determine upon a greater quantity and more varied supply of apparatus for the use of classes.

Mr. Walter C. Wormald a member of Cincinnati class No. 1, travels farther to his class meetings than any other class member in the country, going each week from his home at Maysville, Ky., a distance of sixty miles, returning the following morning.

The Denver class under the aggressive management of Mr. F. D. Wallaker, Western representative for the school has passed the hundred point in membership. This is now the largest class of the school, the Omaha class being next with eighty-four members.

Professor Jackson of the University of Wisconsin has been spending some days in Chicago going over his part of the work of the school—strengthening lessons, adding apparatus for the use of classes, and otherwise preparing for the beginning of the second year's work.

The first classes organized in Chicago last May and June have all closed their year's work, the examinations for most of them are over, and the members are awaiting the result with what patience they can muster. The papers are now in the hands of members of the faculty and the percentages will be ready about June 15th.

Mr. Charles Yagerlauner of the Ft. Wayne class has recently been appointed chief electrician for R. Ogden & Co., of Ft. Wayne. Mr. Yagerlauner was for several years an armature winder and assistant in the Belding Motor Company of Chicago, and he is to be congratulated on his new and well deserved success which his perseverence and energy have brought him.

The Kansas City Class is especially favored in its work, the board of education of the city having at the organization of the class granted the free use of the high school lecture room, and the splendidly equipped laboratory. This action of the board was brought about by the active cóoperation of Professor G. B. Morrison, Professor of Physics of the high school, who is also instructor for the class.

The Young Men's Christian Association in many of the cities where the school has organized classes, has aided the work materially by providing the members with a regular place of meeting free of expense. Education is directly in the line of Association effort, and where it is not in position to furnish the instruction itself, it has stood ready to help in any possible direction. This is a broad liberal policy to pursue.

Among the new classes recently organized are one at Denver, Col., composed of 103 members, with Mr. Irving Hale of the General Electric Company as instructor, and one at Omaha, numbering 84 members, with Mr. W. F. White of the New Thompson Houston Electric Light Company as instructor. Both the classes include in their membership the best men in the electrical business in their respective cities.

In answer to a large number of inquiries from students whose class work for the year is about to close, it may be stated that arrangements are in course of perfection for giving advanced work including laboratory practice, in the near future. This service will be given in Chicago, New York, Philadelphia, St. Louis, Minneapolis and Cincinnati at first, as those cities contain a sufficiently large number of students to justify the expenditure, but other localities will be taken up in rapid order.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

The Chicago West Side Business Men's Association at a meeting on May 29th appointed a committee of five members to wait on Commissioner of Public Works Kent with a demand that he immediately cause the removal of all telegraph and telephone poles in the down town district. One of the committee, M. G. Townsend, made the statement that a pole was erected in front of his house and that he had chopped it down. The company, he said, had brought action against him, and he had won the suit in court.

This action on the part of the West Siders seems likely to bring up again the old question bearing upon the rights of companies to occupy streets over the protest of residents.

New Orleans has three telephone companies, all with franchises, but as yet the Bell Exchange is the only one doing business. The other two are brand new concerns, as new as the toad stools that pop up after a spring rain. A. F. Moss, who is at the head of one of the new companies, was interviewed a few days ago. He said his company would at once put up poles and wires and solicit patronage. Asked where the exchange would be, he admitted that the site for that had not been selected yet.

An ordinance is before the Duluth city council asking for a franchise for a telephone company. The application is made in the name of W. C. Sargent, though it is believed the Duluth Telephone Company, whose present franchise runs out in four or five years, is behind the new ordinance. The company promises to place all its wires underground and to pay the city $300 a year for each mile of subway.

The Central Company at Wabash, Ind. has given notice that it will meet all rates made by the Home Telephone Company, and that it proposes to occupy the field against any and all competition. It offered to pay the expenses of the Home Company if it would withdraw from the field, but the proposition was declined.

C. P. Wainman, Superintendent of the Northwestern Bell Telephone Company, has issued a circular warning all persons to immediately discontinue the use of all battery telephones other than those furnished by the Bell Company. This action is based upon the recent decision confirming the Berliner patent.

Work on the lines of the Central Union Telegraph Company, in Indiana, has been suspended until it is learned whether the Stromberg Company, which manufactures the instruments it it will use, comes within the Berliner patent decision.

The Oshkosh Telephone Company, capitalized at $20,000, proposes to put an exchange in Oshkosh "without reference to the Berliner decision." J. H. Jenkins and Charles Scribner are leading stockholders and the principals in the move.

The Inland Telephone and Telegraph Company of Spokane, Wash., has issued a circular calling attention to a reduction of rates based upon the use that is made of the 'phones by subscribers. The rates range from $2 to $6 per month.

The Topeka Telephone and Electrical Company, successor to the Harrison Telephone Company, re-organized a few days ago with A. K. Rogers, president; Simon Greenspan, vice president; and S. J. Bean, secretary and manager.

The town council of Mankato, Minn., has before it an application for a telephone and telegraph franchise. Members of the council say there are to be several propositions, and they propose to go slow.

Farmers in the section of country between Sault Ste. Marie and Detroit, Mich., are causing the telephone companies a great deal of trouble by cutting the lines for fence purposes and lightning rods.

The Badger Telephone Company of Berlin, Wis., after trying, without success, to obtain a franchise from the town, entered the city without a franchise, setting the poles on private land.

There is a movement on foot with its impetus apparently at Mitchell, to establish a system of long distance telephones all over South Dakota including the Black Hills Country.

Clinton and Burlington people have applied for a telephone franchise in Muscatine, Iowa, and propose to organize an exchange at that place.

A telephone line between Bryan and Madisonville, Texas, is being agitated.

Light and Power.

The Home Electric Company, successor to the Baton Rogue, La., Electric Light and Power Company, was organized May 24th with a capital stock of $1 0,0 0. Samuel G. Laycock was elected president and C. J. Barrow vice-president. The board of directors is composed of T. J. Buffington, T. J. Kernan, Ed. Wax, E. Farrnbacher, Jos. Gebelin, S G. Laycock and C. J. Barrow.

The Ball Engine Company and the C. & C. Electric Motor Company have recently installed a 60-horse power plant at the Juvenile Female Offenders' Home at Geneva, Ill. If the young ladies of that institution keep up anything like the gait they have been going in the Chicago Temporary Home, heating apparatus would seem to be a superfluity.

On May 27 a fire started in the Corrugated Iron Storehouse of the Sioux City Electric Light Company at First and Court streets doing damage to the extent of $10,000. The main power house was only a few feet distant and was in great danger for a time. The fire was caused by the crossing of two electric light wires.

Lake City, Minn., will have electric lights. The contract has been awarded to Burtis & Howard, of Minneapolis, the figures being $5,388. Sixty arc and 650 incandescent lamps will be furnished. The Ball and Wood Engine Co., of New York, furnishes the 100 horse power compound engine and boiler.

Arguments in the case of the General Electric Company against the Western Electric Company, concerning alleged infringement of patents on automatic regulator for arc machines, have been going on in the United States Court of Appeals at Chicago this week. The decision will be rendered within the next 30 days.

The city of Toledo, Ohio, has granted the Consolidated Electric Light Company the use of its streets, alleys and public places for conduits. No compensation was asked by the city. The company will proceed to install its plant under the direction of C. A. Hart of New York.

Woodland, Cal., councilmen have raised a storm of indignation by voting to decrease the number of arc lights used to light the city and the public buildings. The people have tried electric lighting and they will continue it or know the reason why.

The Wabash Electric Co., at Blue Springs, Neb., is putting a large water wheel in its flume and taking out the two smaller ones that have served for some years. It is expected that the large wheel will give all necessary power without use of steam.

On July 9th the citizens of Mankato, Minn., will vote on an issue of bonds to the amount of $10,000, the money to be used in the erection and maintance of an electric light plant for the purpose of lighting the city and its public building.

The Capital Electric Company of Springfield, Ill., expected to have its new electric light service in operation by June 1. Work has been delayed, however, by reason of some of the apparatus being shipped by mistake to Springfield, Ohio.

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The Evansville, Ind. authorities are agitating a proposition to have the city do its own lighting. They have advertised for bids however for a five year lighting contract with a view to compare figures.

An advance of 25 per cent in rates has been established in Denver by the Board of Fire Underwriters on buildings which have been found to be badly wired.

The Library of Congress has just been equipped with three 175-horse power Ball engines directly connected to Mather generators.

Ardmore, Texas, has a desire to be abreast of the times and is now figuring upon an electric light plant and street railroad.

Santa Anna, Cal., will vote on the issuance of bonds to build and maintain a lighting system.

Elmwood Place, Ohio, will have an electric light service.

Railways.

New Haven, Ind., is to be connected by an electric road with Ft. Wayne, six miles west. A. B. White, of Ft. Wayne, is the promotor of the proposed road, and he has interested prominent men of both towns in the enterprise. It is said that the driveway between the towns is one of the prettiest in the state, and the road is desired more as a pleasure road for fresh air seekers than because of any commercial necessity, though it will give Ft. Wayne connection with the Nickel Plate and Wabash roads, as New Haven is at the junction of the two.

On May 26th Mr. Coffin of the General Electric Company was in Chattanooga, partly for the purpose of inspecting the plant of the Chattanooga Electric Railway Co. It is rumored that when the road is sold by order of the federal court, within the next few weeks, the General Electric Company will bid it in, complete the line to Chickamauga National Military Park, consolidate the offices and power plants and operate the whole as one system.

A rapid piece of street car track construction was done in Chicago between Saturday evening and Monday morning a week ago. Nearly a quarter of a mile of road was made. The company had anticipated an injunction and availed itself of a time to do the work when the manager knew a restraining order could not be issued. In all 1,000 men were at work and the force was changed three times in twenty-four hours.

An electric road is to be immediately built between Columbus, Ohio, and Newark, some twenty-six miles distant. The road will be the only means of connecting about ten thriving towns, including Granville, Reynoldsburg and Hebron. This looks very much like replacing steam.

An electric railway is to be built from Marysville to Auburn, California, for the purpose of affording fruit growers and farmers means for getting their produce to market. It will be in all respects a freight road.

The Manhattan Railway Company of New York is preparing to substitute electricity for steam on its "L" road system. The estimated expense is $2,000,000.

An electric road will be built from Aurora to Chicago. The Sanborn Electric Railway Co. has been incorporated for the purpose with $1,250,000 capital.

The trolley strike of last winter at Brooklyn cost the Knights of Labor Assembly $13,739.

General News.

According to the annual report of the Chicago Fire Marshal there are in Chicago, in operation, 510,088 incandescent lamps, 29,370 arc lamps, and 2,341 motors, aggregating 6,505 horse power. There are 583 lighting stations, using 724.99 miles of cable, and 22,769 miles of conductors. At the usual prices for service and under ordinary conditions, the Chicago installations are, incandescent and power represent a total income to the companies aggregates $4,405,500 for arc lamps, $6,121,056 for incandescent lamps, and $455,350 for power. These figures do not consider telegraph or telephone service.

St. Louis is the best electrically equipped city in the country. It has seventeen electric railways; all its alleys are lighted with incandescent, and its streets with arc lamps, and the private consumption of electrical power is great; yet nothing short of a bicycle girl in tights can shock the old town into anything like activity.

An electric drag saw is in operation in the Northern part of Clarks County, Oregon. It requires only three minutes to cut through a five-foot log. One hundred cords is said to be a fair day's work for the machine.

The congratulations by wire from all parts of the world to the Queen of England upon her recent birthday were so numerous that it took an extra force of operators to handle them.

The reduction in England's debt last year was £8,535,000. The increase in the debt of the United States during the past two years was $119,000,000

Three hundred manufacturing firms employing 400,000 men have during the past three weeks advanced wages from 10 to 15 per cent.

Count Ito, the premier of Japan, began life as a telegraph operator. He manned one of the first instruments ever used in the Orient.

Personal Notes.

Mr. Chas. D. Jenney, President of the Jenney Electric Motor Company has just returned home after a visit of some days in Chicago. The new Jenney works, covering five acres of ground just outside of Indianopolis are about completed, and the company will move into its new home June 15. A complete line of multipolar generators and motors with several new features, and a new controller for travelling cranes, are some of the innovations of the Company, which they will push this summer and next fall.

Mr. R. Leo Van der Naillen, late of California, and who has held several important positions in the far West, has recently been made Western Manager of the Boudreaux Dynamo Brush Company, with headquarters in Chicago. Mr. Van der Naillen is a practical engineer, and will add materially to the strength of his new connection.

Mr. E. J. Wessels, general manager of The Standard Air-Brake Company, of New York, will sail for Europe on July 3, in the interests of the export business of his company. He will visit England, Belgium, France, Germany, Italy, Austria and other countries.

The demand from Canada for the Nashold self-locking cleat has grown to such an extent that Mr. Nashold has gone across the border to arrange for the establishment of a factory there to facilitate the manufacture.

CONSOLIDATION OF PLANTS.

A movement is on foot, it is said, to consolidate the factories of the General Electric Co. at some point in New Jersey. This would include the plants at Lynn, Mass., Schenectady, N. Y., and Harrison N. J. The officers of the company have not made any statement of their intentions in the matter, but rumor has it that they have been offered 100 acres of land and a bonus of $1,000,000 cash, and that the deal is likely to be consummated.

You don't advertise dinner pails in a society paper. See the point? We reach actual buyers.

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Eastern News.

The people living along the route of Lenox avenue street railway line in New York, find it hard to determine just what kind of power the road is using. They find the old cable slot and conduit, but no rumbling cable. The car contacts are made through the slot, but there does not seem to be any grip. But they are not inclined to ask many questions, and as the speed is much greater, stops and startings much quicker, and the whole operation noiseless, they will hardly find fault. The facts are that the old cable slot is used for double copper bar conductors, and the trolley plays in the slot as the cable grip formerly did.

Reports of service, since the road started a week ago, are excellent. As there is no ground return, and as the current is kept entirely under control on the conductors there will be no electrolysis of gas and water pipe.

The alternating current companies of New York seem to feel the necessity for improvement in business equipment. The multiphase motor is gradually coming to the front, and its perfection will hasten the popularity and wider use of polyphase currents The manager of one of the large New York concerns spoke of the coming new era the other day, with a good deal of confidence, and predicted an early revolution.

The new Brooklyn ordinance limiting the speed of cars will at least modify the death rate, as people of that town have been led to expect. It is remarkable that the "car of juggernant" should be allowed such free sway to the detriment of kindred interests when a little energy displayed and applied in the proper direction would prove so affective. A brake that will stop the car, and a fender are not difficult of construction. The capital that has already been spent in defense against accident suits would have provided the system with the proper safety appliances and given to the road perhaps what it can never recover—a good name.

A remarkably compact and efficient engine is displayed in Liberty St. for small isolated plants, made by the Cross Engine Co. It represents the *ne plus ultra* of its kind.

The position of the Wireman's Union of New York seems from personal observation to be so utterly at variance with what its position ought to be that the only inference to be drawn is that there is great want of a strong guiding hand. There is continual conflict between the Board of Walking Delegates and the Contractors' Union—due possibly to a little misunderstanding, that a little diplomacy might easily repair. The "May agreement" that seemed to have satisfactorily settled the difficulty then existing, has been almost forgotten. Contractors employ non-union men on new buildings—and union men therefore feel highly dissatisfied with the union for its lack of effective protection. The gigantic American Tract Societies' building, corner of Nassau and Spruce streets, is at present the center of interest. The Tucker Company having non-union men at work on it.

If the union is to be of real service to its members, there should be wiser counsel in its management.

CAUSE OF HEAT AND COLD.

Some astronomical genius has recently discovered why it is colder at the poles than at the equator. He says that the momentum of the earth in its revolution detaches dust and small particles of solid matter which become suspended in the ether surrounding the earth. This matter then acts as resistance to the earth's revolution and causes heat. Naturally there would be more friction, consequently more heat at the Equator, and at the poles where the motion of the earth is at the minimum, the friction and heat would be likewise lessened. He doesn't go exhaustively into the explanation of the offices of the sun

Send in your subscription to THE ELECTRICAL JOURNAL. Only $2 per annum.

TELEPHONE MEN WILL FIGHT.

Independent Manufacturers Unite to Declare War on the Bell Company. A National Association.

The National Telephone Manufacturer's Association, an organization got up avowedly for the purpose of fighting the American Bell Telephone Company, was created during a three days meeting in the Palmer House, Chicago, on May 25th, 27th and 28th. The companies represented were:

Viaduct Manufacturing Company, Baltimore.
Phoenix Telephone Company, Indianapolis
Utica Fire Alarm Telegraph Company, Utica, N. Y.
Manhattan Electric Supply Company, New York.
National Telephone Company, Kokomo, Ind.
Western Telephone Construction Company, Chicago.
Standard Telephone Company, New York.
Keystone Telephone Company, Pittsburg.
Pittsburg Telephone Company.

Officers were elected as follows:

President—J. E. Keelyn, Western Construction Company, Chicago.
First vice president—J. R. Johnson, Viaduct Manufacturing Company Baltimore, Md.
Second vice president—S. J. Turnbridge, Utica Fire Alarm Telephone Company, Utica, N. Y.
Secretary—Paul W. Bossart, Minneapolis, Minn.

The office of treasurer was left vacant pending another meeting, the secretary being instructed to act in that capacity temporarily.

President Keelyn's address concerning the necessity for such an organization was directed against monopoly of the telephone business.

THE TROLLEY AND INSURANCE RATES.

Underwriters to Increase Their Rates Along the Route of Down Town Lines in Chicago.

There are mutterings of a trolley storm in Chicago that promises to be a typhoon before long. The interests involved are great and the fight will be long and severe.

When Mr. Yerkes was given permission to run his down town lines by electricity a few weeks ago, the insurance people had nothing to say, and said nothing. Immediately afterwards however, the electrician for the American Board of Fire Underwriters, Mr. Merrill, wrote to Chief Swenie of the fire department simply asking if overhead trolley lines would interfere with or embarras him in fighting fires. The Chief replied that any obstruction over head in a street when there was a fire would be an obstacle in fire fighting, and that if the obstruction was in the shape of wires carrying electricity under pressure dangerous to life the interference would be greater. Taking this answer for his que. Mr. Merrill at once advised the Board of Underwriters to increase their rates fifty per cent. Definite action has not yet been taken by the insurance people as yet, but it is thought by those who are posted on the situation that the increate will be made. The owners of property abutting on the proposed lines have not heard of the plotting against them yet, but as soon as they do, they will undoubtedly take a hand, and it is safe to predict an interesting time all along the line.

MAGNETIC CURVE ILLUSTRATIONS.

Mr. E. T. Schoonmaker of Fordham, N. Y., a member of the Harlem class, has prepared some very interesting specimens under glass of magnetic curves obtained by iron filings and magnets with free poles. They demonstrate in the clearest possible way the direction of the lines of force and are both interesting and instructive to students of electricity. Mr. Schoonmaker has already furnished a number of the colleges and universities with his specimens for class demonstration.

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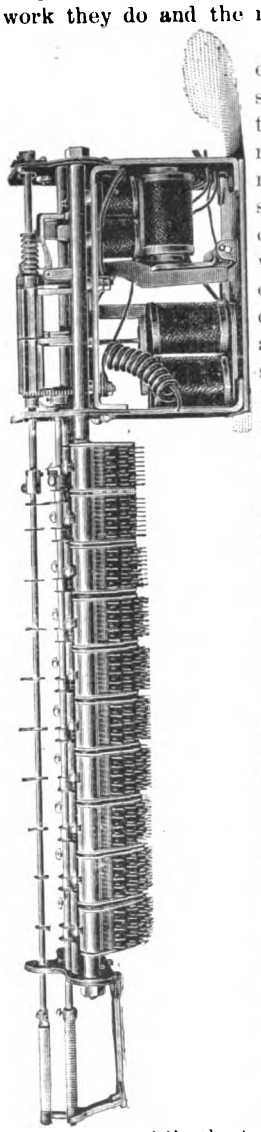
STROWGER AUTOMATIC TELEPHONE.

Improvements Recently Made in Switchboard Make the Instrument Much More Perfect.

The new exchange switches which the Strowger Automatic Telephone Exchange of Chicago is now installing are wonderfully simple and efficient pieces of mechanism, considering the work they do and the rapidity with which it may be done.



A subscriber's switch for a 1,000 wire exchange is shown in the figure and consists of ten banks of one hundred contact points each, and a machanism by means of which the subscriber's wire may be connected to any one of the thousand contact points. There are in an exchange of this size 1000 of these switches, with the corresponding contact points of each connected together as in an ordinary multiple manual board. When a subscriber wishes to connect his instrument with that of another subscriber, he operates, by means of push buttons, the mechanism in his exchange switch operates in such a manner that one of the fingers on the right hand vertical rod, as shown in the figure, comes in contact with the point belonging to the subscriber wanted. The same operation works auxiliary mechanisms which prevent a third subscriber from cutting in on either of the two wires which are busy.

Between a subscriber's instrument and his exchange switch are two wires forming a common metallic circuit. Besides this there is a common battery wire which connects with all the telephone instruments connected with the exchange. On the face of a subscriber's instrument there are three push buttons marked "Hundreds," "Tens," "Units." With the three wires entering the instrument, three circuits may be formed. The battery wire and one of the metallic circuit wires are used in connection with the hundreds and units pushes: the battery wire and the other metallic circuit wire are used with the tens push; while the two wires composing the metallic circuit are used in calling and talking with the subscriber wanted.

The process of connecting and calling is very simple. Suppose the number 231 is wanted. The telephone receiver is first removed from the hook, then the hundreds button is pushed twice, the tens button three times and the units button once. The bell is then rung in the ordinary manner to call the subscriber wanted. If the latter is busy the one calling cannot ring his bell and thus knows that he must wait and call again. The hanging up of the telephone receiver throws the automatic switch back to zero.

The company has already installed some twenty exchanges ranging from a few instruments to several hundred and all seem to be giving satisfaction. No attendant whatever is employed at the exchange, and cases of trouble are so rare that the system may be said to be practically perfect.

The old steamer Columbia, of San Francisco, is undergoing repairs and will have a complete equipment of electrical machinery. The fact is interesting only because the Columbia received the first installation of electric lighting apparatus ever put into a boat. The old equipment has been in for *fifteen years.*

POSTAL SERVICE TOO SLOW.

Patrick B. Delany, a veteran telegrapher, thinks that the government could do the work now covered by the postal service vastly better by means of the telegraph, says the Pittsburg Dispatch. Of course radical changes will have to take place.

Mr. Delany shows that at present it costs the telegraph companies three cents to bring a message from a customer to the office and another three cents to deliver it. As this rate is based on an average of twenty words per minute with hand transmission and sixty words per minute the quadruplex working, it is is easy to understand that the companies cannot telegraph for less than existing rates.

But hand working and great numbers of cheap wires will soon be things of the past. Automatic systems and a few big copper wires reaching out to the principal cities will have a vastly increased capacity, and will before long be employed to carry quantities of correspondence which at present we do not dream of.

Mr. Delany says: "Why should the government insist on carrying our letters by train at thirty miles an hour instead of by telegraph? Why waste twenty-four hours in covering the distance between New York and Chicago? There are about 30,000 letters exchanged between New York and Chicago daily.

"Assuming that they average fifty words each, all could be telegraphed over two copper wires the size of a lead pencil, and with time to spare. It has been demonstrated that with the automatic chemical method 1,000 words per minute can be recorded perfectly between New York and Chicago over a one ohm per mile wire.

"Messages can be perforated at the rate of twenty-five words per minute, and typewriters can print from the received tape at the same speed. On this basis letters of fifty words could be perforated, transmitted, printed, and delivered through the mails at a cost of about five cents."

This is what Mr. Delany, says we are coming to if the government will only take hold of the work. It will be curious and interesting to watch the bearing of the enormous development of telephony which is close at hand, and to see what part it will play in the cheapening of telegrams, whether the government acquires control of the telegraph service of the country or not.

TROLLEY ABOVE THE CLOUDS.

Road to Be Built to the Top of the Queen of the Alps—Five miles of Tunnels.

An electric trolley road is to be built to the top of the Jung Frau peak, the highest point in the Swiss Alps. The length of the road will be eight and a half miles, five of which will be through tunnels. The road will begin at the present railroad station Scheldegg 6,500 feet above the sea and will terminate two hundred feet below the highest point of the mountain, 14,000 feet above the sea. The longest single tunnel will start at the foot of the immense Eiger glacier, and run directly through the solid mountain to the Grindel Wood, on the opposite side. The system used will be the ordinary overhead trolley, excepting that the cars will be much heavier and stronger. It will take two hours to make the single trip—largely because physicians have declared it to be imprudent to allow persons, not entirely free from heart and lung troubles to ascend more rapidly. It is expected that the road will be ready for operation in 1900.

The American Institute of Electrical Engineers will probably have a very pleasant time of it at Niagara Falls, the place of next meeting, June 25th to 28th. The power transmission plant will be duly inspected, and the roar of the Falls will be accompanied by "raws" of an equally inspiring description.

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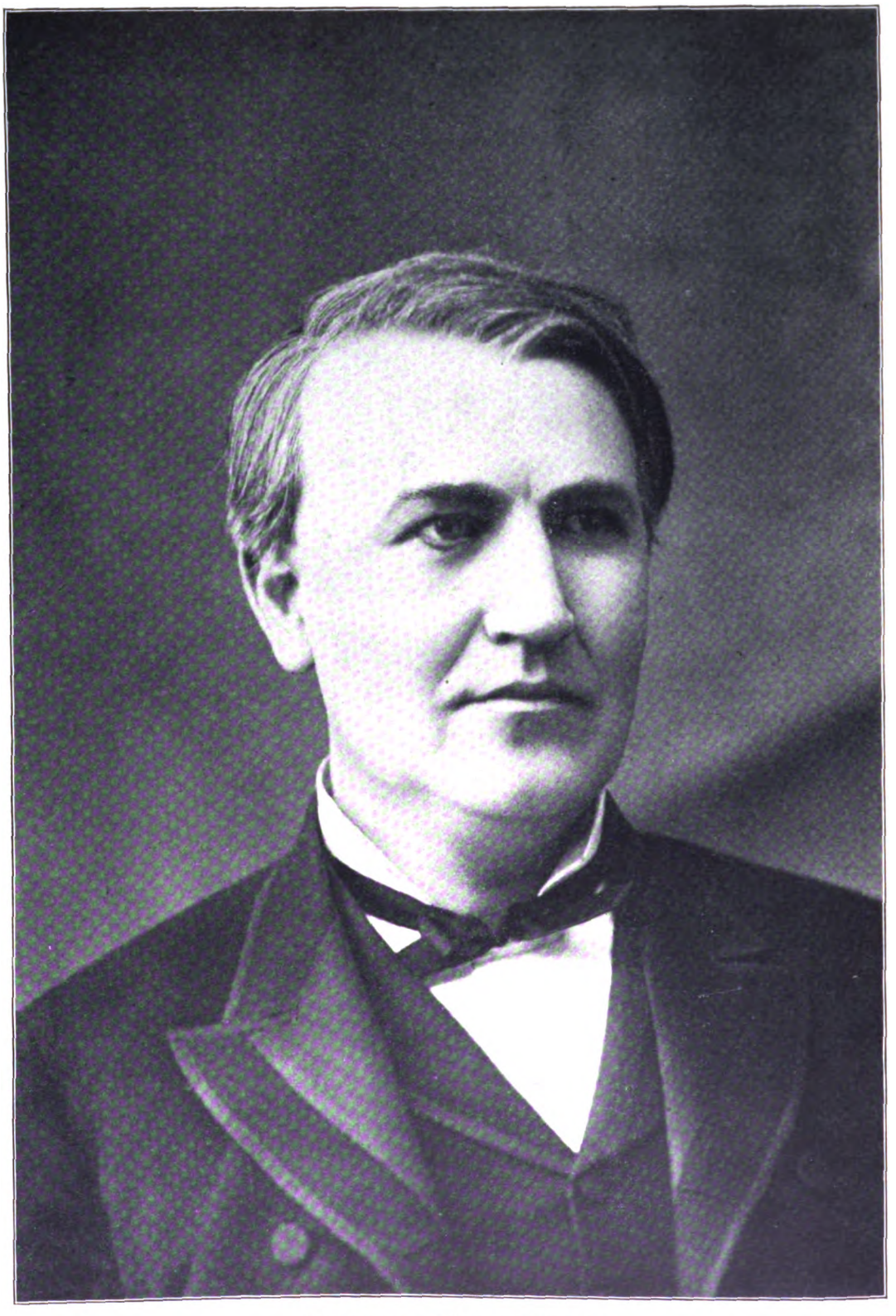

THOMAS ALVA EDISON.

Born at Alva, Ohio, in 1847. Inventor of the Edison Dynamo, Incandescent Lamp, Quadruplex Telegraph, Stock Exchange Telegraph, Carbon Dust Microphone, Phonograph and Kinetoscope.

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The Electrical Journal.

Vol. 1. CHICAGO, JUNE 15, 1895. No. 2

STREET RAILWAY CIRCUITS.

Electrolytic Action in the Ground Return Caused by Leaks, Due to Imperfect Bonding and the Use of Small Ground Plates.

PROPER CONSTRUCTION MEANS ECONOMY.

The track of an electric road has a double duty. Like the track of steam, cable and horse roads, it furnishes a hard and smooth surface upon which the car wheels may roll. On nearly all electric roads the rails are also part of the electric circuit. Methods of track construction have been highly developed on the steam railways. The conditions to be met on street railways are somewhat different, since the streets are often paved, and the track must be laid in such a way that it will need no repairs for a long time.

A large variety of rails are used on street railways. The older street railways used flat rails, spiked to wooden stringers run lengthwise, but were not connected together otherwise. For light traffic this construction was satisfactory, but with heavier cars and heavier loads the ends of the rails soon battered up the wooden stringers, and the track became rough at every joint. The common practice, at present, is to use "T" rails as on steam railways. Where it is necessary to pave the streets close to the track, girder rails are much used. The rails are 30 feet long and vary in weight from 35 to 110 pounds per yard.

The common practice is to fasten the rails to cross ties of sound oak and chestnut by means of hooked spikes 4½ inches long. The ties are bedded in clean and solidly tamped gravel, or are laid in concrete. In some cases the rails rest on cast or wrought iron chairs, which are spiked to the ties, and which give a broader surface between the wood and iron.

With rails of the "T" and girder patterns the rail-joints are strengthened by fish-plates bolted to each rail. Sometimes special chairs are used at the joints, in order to give larger bearing surfaces between the rails and the ties. An excellent form of construction, using girder rails, wrought iron chairs and oak ties bedded in concrete, is shown in Fig. 1.

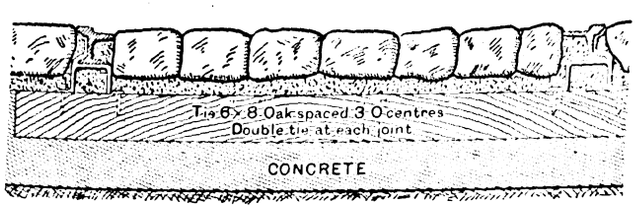

FIG. 1.

The rails should be very stiff and should be firmly fastened to a solid foundation, so as not to yield much under the weight of the cars. Electric motor cars are much heavier than cable or horse cars, on account of the weight of the motors, the stronger construction of the trucks and the larger size of the cars. Since the motors are generally hung directly upon the car axles, there is a considerable amount of dead weight on each pair of wheels, and every irregularity in the surface of the track causes a hard "hammer blow" as the wheels follow the irregularities in the track. With the latest motors the "hammer blow" is reduced by having the greater part of the weight supported on springs, which prevents much of the shock.

On most electric roads the rails constitute a part of the return circuit, and it is necessary to consider them as electric conductors. Iron and and steel have only one-seventh the conductivity of copper. A ninety-pound girder rail, such as is frequently used, has a cross-section 8.9 square inches, which is equal to more than fifteen copper trolley wires of No. 0, Brown and Sharp Gauge. If this rail were continuous without joints, the two rails of a single-track road would have a resistance of only 0.018 ohms per mile. This would give a return circuit of very low resistance. However, the rails come in sections 30 feet long, and there are at least 176 joints in each rail per mile. Unless the joints are carefully bonded, they increase the resistance greatly.

Experiments are being made in some cities with rails welded together so as to avoid all joints. The rails are welded together by a special welding car that takes about 250 amperes at 500 volts from the trolley wire and transforms it to an alternating current

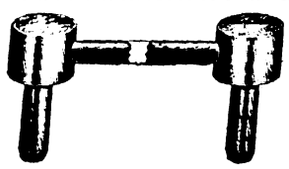

FIG. 2.

of about 25,000 or 30,000 amperes at 4 volts. This enormous current quickly heats the ends of the rails and the fish-plates to a welding temperature. Another method of rail welding is by means of a portable cupola, by which iron is melted and poured around the joint so as to make it solid.

The more common method of obtaining good electrical connections between the rails is by means of copper or galvanized iron bonds. Copper is generally used, although in some places iron seems to last longer. The bonds vary in size from No. 6 wire to bars ¾ inch thick. In Minneapolis a plate of cast copper 3-16 inch thick and 2¼ inches wide is largely used. The bonds are riveted into holes drilled through the web or flange near the ends of the rail, and make a water-tight connection. It is good practice to paint the bonds with shellac and to paint two coats of asphalt upon this. A very common form of bond is shown in Fig. 2. A more recent form, shown in Fig. 3, has the advantage of a large area of contact with the rail. On the Pacific coast it is common to drill holes into the ends of the rails and to drive in copper dowel pins, which form short and firm connections between the rails.

The two rails, or all four rails on double track roads, are cross-connected at intervals which vary in different cities from 60 to 300 feet. The reasons for cross-connecting are that the bonds sometimes break on account of the up-and-down motion at the rail joints, or become corroded by electrolysis or other chemical action. On some roads it is usual to double-bond each joint. The aim is to make the conductivity at the joints equal to that of the rails. On one double-track road the resistance of the rail circuit was reduced from 0.048 ohms per 1,000 feet with No. 6 galvanized iron bonds, to 0.006 ohms with heavy cast copper plate bonds.

On account of the difficulty in obtaining satisfactory bonding, some roads have reinforced the return circuit by large supplementary wires buried between the rails and bonded to each rail. The supplementary wire is unnecessary where the track is well laid and well bonded. An equal amount of money

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spent in good bonding would give much better results. The track circuit is connected at different points with the power house by means of track feeders. These may be buried, but are often run on over-head lines.

On most roads the rails are connected with the ground at intervals of 500 to 1,500 feet, so as to use the earth as a part of the return circuit. Moist earth is a fairly good conductor, and since the area of cross-section is very large, the resistance between any two points is small. The difficulty is to secure a large surface of contact between the earth and the metallic portions of the circuit. In order to obtain ground connections of low resistance, it is common to connect the rails with car wheels, rails or plates of copper which are buried deep enough to be in earth that is always moist. In cold parts of the country, care must be taken to get below the frost line, because frozen earth is a good insulator. Sometimes galvanized iron rods or pipes are driven deep into the ground at frequent intervals, being carefully connected to the rails. Connections are often made to gas and water pipes, so as to get a large surface of contact with the earth and so as to use the pipes as conductors.

The main object of the street railway company in carefully bonding the rails or in obtaining good electrical connections with the earth, is to obtain a return circuit of very low resistance so that the loss of potential and of energy will be small. But in avoiding this loss, trouble from another source is also avoided. It is a well known fact that chemical action is generally caused when electricity passes through a liquid. The liquid is separated into different parts, which in many cases form other substances by uniting with any suitable material that is near. Most of this *electrolytic action* takes place at the points where the current

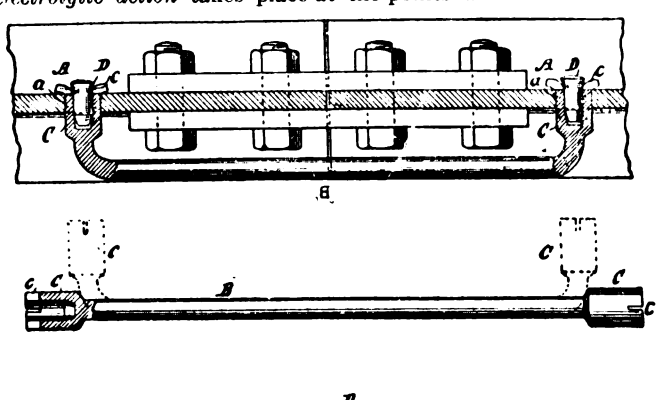

FIG. 3.

enters and leaves the liquid. The *anode*, or the part of the solid conductor where the current enters the liquid, is generally corroded or eaten away, while the *cathode* is usually not much affected. The amount and character of the chemical action depends upon the length of time, the quantity of current flowing, and upon the difference of potential between the anode and the cathode.

When the earth is used as part of the return circuit, it is impossible to avoid electrolytic action entirely. The ground plates connected with the track and with the power-house are anodes and cathodes in a large electrolytic cell in which the moisture of the earth is the electrolyte. The moisture is not simply water, but it holds in solution various substances which increase the chemical action of the current.

Whenever a difference of potential exists between any two points connected by a conductor, the current varies in proportion to the conductivity of the circuit. When two such points are connected by a number of paths, the current divides among them according to their different conductivities. It follows that since the return circuit of an electric railway has more or less resistance, there are differences of potential between the ground connection at the power-house and various portions of the track. The current therefore divides and follows different paths. In some places, parts of the earth are more or less insulated by strata or layers of clay, hard-pan or other materials that do not hold much moisture. The small surface of the ground connections and the imperfect bonding of the rails, are other causes that produce a fall of potential when cars pass certain points. As a result part of the current returns by other paths, which are often water and gas pipes, or lead-covered telephone cables.

The current usually does little harm where it enters such pipes, but more or less corrosion takes place when they become anodes and the current leaves them to pass through the earth to other points. If such pipes have insulated joints (caused by rust, packing or otherwise), the current will pass around the joint and electrolysis will occur. If the joints are perfect and the pipes are well connected, both to the rails and to the power-house, little damage is caused by the current. Since corrosion is greatest at the point where the current leaves the metallic conductor, it is customary to make the trolley line positive and to connect the negative side of the power generators with the water and gas mains in the neighborhood, as well as with the ground plates and the track feeders.

On account of the trouble from electrolysis, which sometimes eats holes entirely through pipes and causes damage from leaks and weakened insulation, this subject is one of great importance and is receiving much attention. By thorough bonding and by the use of track feeders the current may be kept in its proper paths.

Geo. L. Shepardson.

ELECTRICAL ENGINEERS' MEETING.

American Institute Will Hold a Four Days' Session at Niagara Falls—Live Questions Will Be Discussed.

The general meeting of the American Institute of Electrical Engineers will be held at the Cataract House, Niagara Falls, beginning Tuesday, June 25, at 10 A. M. and will continue four days. The session will be an interesting one, and a number of important papers will be presented. The list comprises:

1. "The Substitution of Electricity for Steam in Railway Practice" (inaugural address), by the president, Dr. Louis Duncan, of Baltimore.
2. "Properties of Fuse Metals When Subjected to Short Circuits," by Walter E. Harrington, of Camden, N. J.
3. "Location of Grounds in Armatures, Fields, Etc.," by Clarence E. Gifford, of Jamestown, N. Y.
4. "Some Features of Alternating Current Systems," by Charles P. Steinmetz, of Schenectady, N. Y.
5. "Theory of General Alternating Current Transformer," by Charles P. Steinmetz, of Schenectady, N. Y.
6. "Compounding Dynamos by Armature Reaction," by Elihu Thomson, of Lynn, Mass.
7. "Existing Commercial Applications of Electrical Power from Niagara Falls," by W. L. R. Emmet, of Schenectady, N. Y.
8. "Alternating Current Curves," by Dr. C. E. Emery, of New York.
9. "Electric Power in Factories," by Professor Francis B. Crocker, Messrs. Benedict and Ormsbee of New York.
10. "Some Observations on a Direct-Connected 300 Kilowatt Monocyclic Alternator," by Professors Dugald C. Jackson and S. B. Fortenbaugh, of Madison, Wis.
11. "On Mechanical Models of the Electric Current," by Professor Brown Ayres, of New Orleans, La.
12. "On the Cause of Death in Electric Shock," by Albert M. Bleile, M. D., of Columbus, O.
13. "Long-Distance Power Transmission at 10,000 Volts" (the Pomona plant), by George Herbert Winslow, of Pittsburg.
14. "Notes on the Reconstruction of a Small Central Station Plant," by Franklin Leonard Pope of Great Barrington, Mass.
15. "On Rating the Performance of Electric Power Plants and Transmission of Varying Loads," by Professor William S. Aldrich, of Morgantown, W. Va.
16. "Work of the Westinghouse Electric and Manufacturing Company for the Cataract Construction Company, of New York," by L. B. Stillwell, of Pittsburg.

The members will visit the works of the Niagara Falls Power Company, the Niagara Falls Park and River Railway on the Canadian side, the alluminum plant of the Pittsburg Reduction Company, the plant of the Carborundum Company, and the central station of the Niagara Falls and Buffalo Electric Light and Power Company.

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PERFECT BLOCK SIGNAL SYSTEM.

Seven Hundred Trains A Day, Without An Accident Since the Inauguration of the System in 1891.

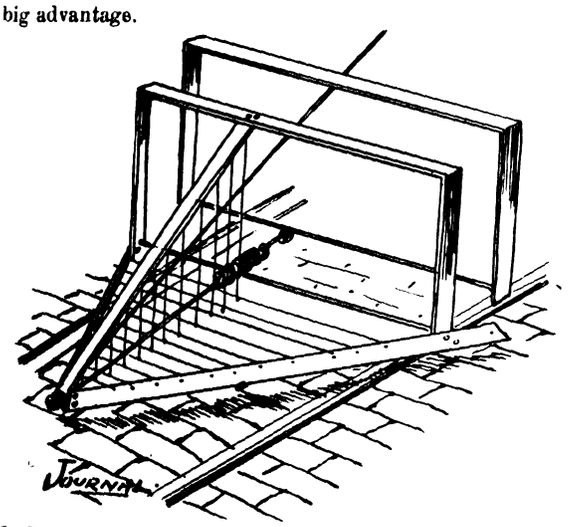
Though handling 700 trains a day, the signal system of the Pennsylvania road at Jersey City, has never had what could be scheduled as an accident.

The system covers about a mile of road, from the depot at the river to New Jersey Junction, with an interminable net work of tracks and switches, and on an average there are about ten trains passing or switching continuously. Three men in the tower outside the big depot handle all the switches, having a map of the road before them on the board. One of these men is the train director, who stands where he can look over the whole "yard;" the second is the operator, with his finger on the telegraph key and his eye on the clock-like train describers before him; the third is the lever-man, who stands facing the bay window at the switch machine, which is over sixteen feet long and over four feet wide. The switch machine has thirty-six levers, each lever controlling about twelve switch combinations. The machine was erected in 1891, and its theory of construction is a puzzle of electric circuits and nicely adjusted connections. Its purpose is accomplished by an underlying network of wires run underground in wooden boxings to all switches and signals under its control. The force which supplies the entire train-yards system of electric signalling and lighting, is generated in the great powerhouse of Jersey City, some distance down the tracks.

There is a sixty-five-pound air pressure operating the switches, the supply of compressed air coming from the Waldo avenue yard through a system of pipe connections, while a small reservoir of compressed air is placed at each switch and signal in the guise of the familiar brown-painted iron cylinders beside the tracks. The switch-tower has made a record of over one hundred and thirty train moves in an hour, and with an average of a train every two and a half minutes.

NEW FENDER FOR ELECTRIC CARS.

Fenders for electric street railways are popular inventions just now. The latest, and one that promises a good deal of success is that designed by Eugene Reiley of Oakland, Cal. It is a self-worker, constructed of steel and in the shape of a triangle inlaid with a set of springs. It is made to run within half an inch of the road bed, and this fact alone Mr. Reiley considers a big advantage.



Mr. Reiley has been an inventor for a good many years, and a number of his patents are in use all over the United States. Some years ago he invented a gate-pipe coupling, which was received with general favor.

Bicycle riders are now using electric headhights attached to their caps.

NEW LOCOMOTIVE ELECTRIC HEADLIGHT.

For a long time inventors have been experimenting with a view to overcoming some of the difficulties attendant on the use of electricity for lighting locomotives. The latest improvement recorded is that of G. C. Pyle of Indianapolis.

The generator is mounted on the top of the smoke box, behind the headlight projector, and either before or behind the stack. It is driven by a compound steam turbine of high speed. The steam is expanded four times before it is exhausted into the atmosphere. The governor is on the turbine wheel. Dynamo and turbine are on one base plate, which is attached to the engine in such a manner as to preserve the alignment. The armature and commutator, which weigh but twenty-three pounds, are on the engine shaft which runs at 2,000 revolutions per minute. The electrical balance of the dynamo is said to be so perfect that no spark can be seen at the brushes. The electric lamp can be placed in any ordinary headlight reflector by removing the oil lamp. Only one carbon is employed, a short piece of copper being used for the negative electrode. By the operation of a solenoid magnet this is drawn away from the carbon, and thus establishes the arc or light. The entire plant is nineteen inches long and weighs 211 pounds, the weight of the lamp being fifteen pounds. The only wearing surface is the shaft, and this runs in oil. The two bearings are three and a half and six and a half inches long, and the weight of shaft, armature and turbine wheel is but forty pounds. As there are no internal wearing parts requiring oil, it is not considered necessary to supply a sight-feed lubricator in the cab for the dynamo. One five-eighths inch carbon, costing one and a quarter cents, will run about eight hours, which, it is claimed, practically constitutes the expense of running the light for that length of time. Among the claims made for the device are that in operating the plant dry or wet steam may be used, and it is said to make no difference if a full head of high-pressure steam is suddenly turned on, as there can be no reaction or backlash. The whole mechanism may be started with one turn of a half-inch valve.

SOME PERTINENT FIGURES ANENT THE CABLE.

British Capital Preparing to Sink Seven Millions In the Pacific Ocean Purely for Politics.

The telegraphic cable between Vancouver and Hawaii contemplates some immense distances, and much money. The route of the cable will be from Vancouver Island to Fanning Island, in the South Pacific, a British possession 1,200 miles from Honolulu, and 3,860 miles from Victoria, the way a crow flies. From Fanning to Fiji, the next stopping place, the distance is 1,967 miles, and thence to Auckland the distance is 1,848 miles. From Auckland to Sydney, New South Wales, there is already a cable. The total length of cable to be laid therefore is 7,200 statute miles. The proper kind of cable costs laid $1,000 per mile, making a total cost of $7,200,000. In order to earn six per cent. on this money it would be necessary to send annually 432,000 words at $1 per word, the proposed rate. As repairs and operation are items of great expense in submarine cable work, the receipts would require to be double the above amount in order that six per cent. could be earned. In other words, it would be necessary to send 1,000,000 messages a year of ten words each, or one such message every twenty minutes.

It would be interesting to know how much of the inevitable deficit the British government is to stand on the score of the preeminence the cable will give her in the Pacific.

A private letter has just been received from a Jesuit Missionary resident in China for a number of years, urging a relative in the electrical business to come to China by all means, as the country will be immediately thrown open, and that electrical appliances of all kinds will be in great demand.

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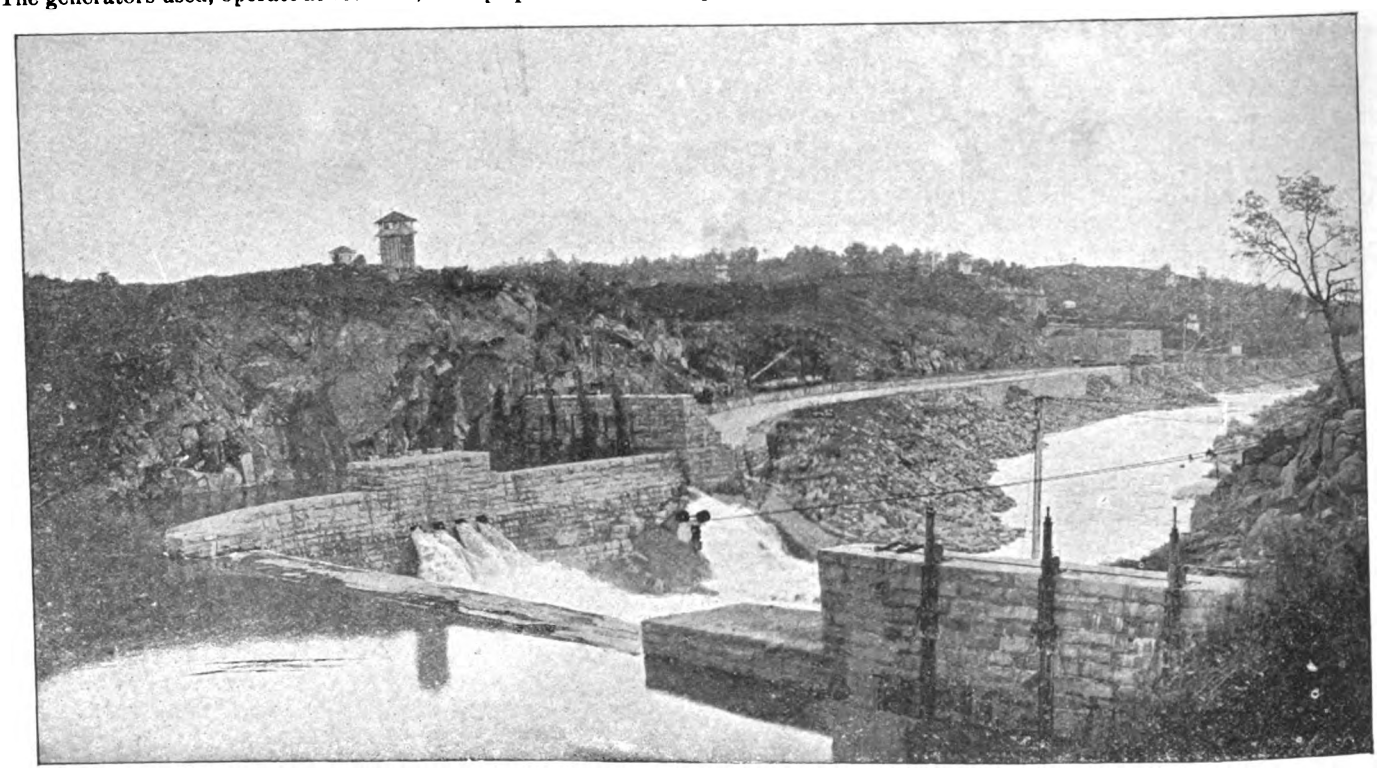
FOLSOM-SACRAMENTO PLANT.

Transmission of Five Thousand Horse Power Over Fifteen Miles—Completion of a Great Commercial Achievement.

SACRAMENTO DRAWS THE EYES OF THE WORLD.

The Sacramento-Folsom transmission plant is practically completed, and will be giving light and power service in the City of Sacramento by June 22nd. This installation will go very far toward settling the question of transmission of energy by electricity, over long distances which we have been waiting for so long.

The distance between Folsom, on the American River, to Sacramento, over the route proposed, is about fifteen miles. The generators used, operate at 800 volts, to step up transformers at 11,000 volts. Under this pressure the current is conveyed over the route to the Sacramento plant where it is retransformed down to 125, 220, 500, 1,000 and 2,000 volts as may be required. The first machine set in operation is a 1,000 horse power, General Electric, three phase alternating current generator, weighing thirty tons. When the plant is completed, there will be three other machines of the same character and size.



The plant is a model of civil, mechanical and electrical engineering. The dam is a massive structure of granite laid in Portland cement. It is 650 feet long, 89 feet high in the centre, 87 feet wide at the base, 25 feet wide in the crest, and contains about 48,590 cubic yards of solid masonry. It is provided with a heavy wooden shutter or flashboard six feet high which at high water is lowered into a recess in the crest of the dam. At low water this shutter is raised by hydraulic pistons, the depth of the basin is increased by six feet and additional storage capacity for the waste water provided. Normally the dam forms a storage basin or reservoir three and one-half miles long, and has a capacity of 13,000,000 cubic yards of water.

At each side of the dam are massive granite bulkheads and three head gates operated by hydraulic machinery, each head gate being 16 feet wide. The West Side canal is 40 feet wide at the top, 30 feet wide at the bottom, and six feet deep. It is intended principally for irrigation purposes.

The power house is situated at the extreme end of the canal where a fall of 55 feet is available at high water. It is on the west side of the town of Folsom, where an immense cut in solid rock has been made, about 60 feet deep, 100 feet wide, and 150 feet long, from which a channel 40 feet wide leads to the river.

The hydraulic apparatus consists of four pairs of wheels of the McCormick horizontal shaft turbine type, enclosed in steel cases, having steel inlet pipes, eight feet in diameter and double discharge tubes. By this arrangement in pairs, the end thrust is neutralized and sufficient power and speed is developed to allow of direct connection to the generators. Each pair of wheels has a capacity of 1,260 H. P. at 300 revolutions per minute. They embody all that is latest and most improved in hydraulic practice, and are of larger capacity than any hitherto constructed in this country with one exception. They are operated under a head of 55 feet. The hydraulic plant also includes two special horizontal wheels for the exciters. The water after having passed the turbines is discharged through tunnels under the power house into irrigation canals for distribution over the country south and east of Folsom. The wheels and generators are located on the first floor of the building power house sixteen feet above the level of the water in the tail race, but do not occupy the same room. Between the wheel room and the generator room a heavy masonry vault has been built. The openings through which the turbine shafts pass are small and the wall serves to protect the electrical machinery from the possible entrance of water. The water wheel regulators are in the dynamo room and the operator thus has full control of the hydraulic machinery in sight of the electrical instruments on the switchboard. Both dynamo room and wheel room are provided with traveling cranes.

In the second story of the power house directly over the dynamo room the substation step-up transformers are installed. These are the standard type General Electric Company transformers. In these transformers the voltage, generated at 800 volts is raised to 11,000, and connections to the line are made through marble switchboards equipped with necessary switches and fuses. The current is carried at this high voltage over 2,600 40-foot poles, on two circuits of three copper wires each, supported on double petticoated porcelain insulators, each insulator,

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before use, being exposed to a test of not less than 25,000 volts alternating.

At the sub-station in Sacramento, the transformer switch boards receive the terminals of the 11,000 volts transmission lines, and operate the different transformer combinations. The transformers at the sub-station are of the air blash type, and vary in size corresponding to the work to be performed. Three 300 horse power, three phase synchronous motors, General Electric type, directly connected to a line shaft, drives several 500-volt continuous current railway generators and a number of arc machines.

The incandescent lighting, commercial arc lighting and stationary motor work in the central portion of the city is effected on a low tension modified Edison three wire system, by feeders from the secondaries of the step-down transformers supplying current to a net work of mains. The motors are of the three-phase induction type and capable of connection to the mains at any point. The street arc lighting is done on the constant current series system, while outlying motors are operated from higher potential lines with individual transformer reduction, or with high potential synchronous motors.

Many features in this plant are improvements over any work of the kind yet attempted, and much interest is aroused in its behalf. It will undoubtedly be the precursor to many similiar undertakings, especially in that far Western country, where there is unlimited water, scant fuel and plenty of push.

NEW GERMAN RAPID TRANSIT RAILWAY.

The bicycle railway seems to have suffered a collapse in this country, but in Europe they are still trying to keep life into it, if indeed they are not about to resuscitate it into something useful.

Information has recently been received, of an invention developed by Herr Langen. It does not appear that any line has yet been built, with the exception of a small trial section at Deutz, near Cologne. The scheme comprehends suspending the cars from an overhead structure and operating them by electricity; in fact, it might almost be termed a conduit electric railway inverted. In place of the conduit, however, is an overhead longitudinal structure like a box girder, with latticed members, the open side being beneath. This is carried by posts planted at intervals along the curb line and supporting an arch which spans the thoroughfare. The girder or longitudinal structure not only carries the conductor wires for the power, but also the track upon which the motors run, from which the car is suspended. There are two four-wheeled trucks, one at each end of the car, and the car is suspended by a center bolt from each truck, suitably provided with springs to insure easy riding. The customary springs are also interposed between the truck axles and the truck frame carrying the motors. Derailment is provided against by friction plates, which bring up against the rail, which is of peculiar form, on its bottom, and the brake system comprehends, besides the customary brakes on the wheels, others which seize the rail top and bottom. Each truck has a single motor. The cars, of course, hang perfectly free of the structure, and the center of gravity being low, high speeds are claimed to be possible. Beside the double line of posts and the arched girder over the street described, the line may be carried on a single or double set of posts placed in the middle of the roadway. In following the line of a canal, it is proposed to suspend the cars over the waterway, inclined latticed struts extending from each bank to a short horizontal section carrying the longitudinal girders. Whatever the form of overhead construction, the stations are carried by the same means and consist essentially of a platform with shelter, 16 to 18 feet above the street level, communicating with the surface by stairways.

DIFFICULTY OF REPAIRING OCEAN CABLES.

Four Months, and Three Hundred Thousand Dollars Spent In a Single Instance.

Repairing ocean cables is not only tedious and costly work but requires the utmost experience and expertness

The recognized mode of procedure when a fault has been discovered is for the repairing steamer to proceed to the spot where the fault has been located, put down a mark buoy, let down the grappling hooks and begin fishing for the cable. The cable is not always there. It often drifts out of its correct position, and cases are known in which it has moved eleven miles from where it was laid down. Last summer two repairing ships were trying for four months to repair a certain cable that was lying in deep water. The bill for their failure was $300,000, not counting the cost of cable hacked to pieces in the endeavor to recover it. The difficulty of the task can be appreciated when it is stated that the cable was lying at a depth of 2,597 fathoms, or nearly three miles. As soon as these ships were withdrawn, the Minia, a ship of about half their size, went to the spot and straightway repaired the cable. The same ship has a record of a 110 repairs during the the last ten years without a single failure. All this time she was under the command of Captain Trott, a veteran submarine telegraph man, so that the inference may be fairly drawn that in cable repairing, as in so many other things, there is a great deal in knowing how.

CO-OPERATIVE TELEPHONE SCHEME.

An application for the incorporation of the Oberlin Telephone Company of Oberlin, Ohio, has been filed with the Secretary of State. The capital stock named is $10,000 in two hundred shares of $50 each. The incorporators are W. H. Pearce, E. P. Johnson, A. G. Comings, W. B. Bedortha, and F. L. Fuller. It is propossd to organize a mutual company, each subscriber for a telephone becoming a stockholder, a rental to be charged for the telephone and a credit being given for the service at profits, enabling the users of telephones to get the service at actual cost. When the certificate of incorporation is received the books will be opened for subscriptions.

London, Glasgow, Belfast and Dublin are now connected by the long distance telephone. Rates range from 62 cents to $187 for three minutes conversation.

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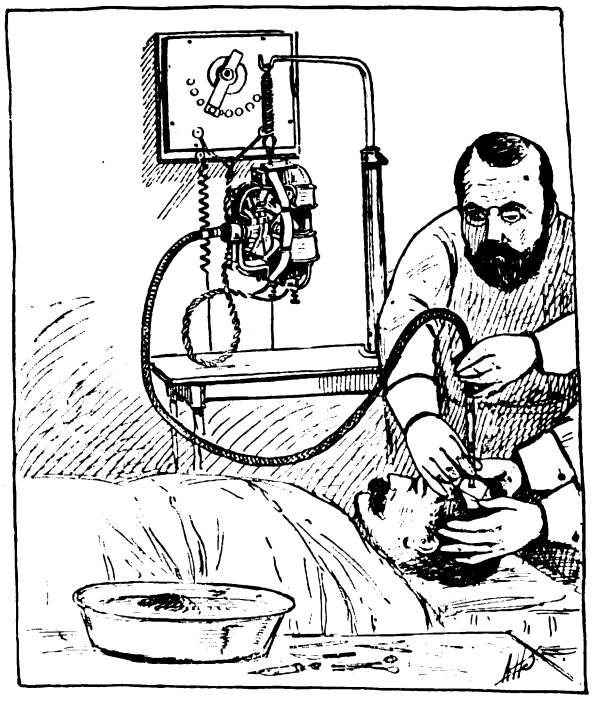
ELECTRICITY FOR THE SICK.

Heat, Light and Power in Public Hospitals. Phonographs to Amuse. Bathing Sunstroke Patients. Cooking at the Bedside.

LUXURIES ALIKE FOR THE RICH AND POOR.

Among the first considerations in hospital practice, are those of economy in time and labor. Attendants as a rule, must minister to a large number of patients, hence can devote a minimum of time and attention to the individual. All remedial agents, and appliances of every sort must conserve these conditions to be of real and lasting value.

The administration of electricity, at least in some of its forms, requires close attention, and sometimes as much as half an hour of time. This is especially true in electrolytic work, and in the applications of static electricity. Patients, especially in large public institutions cannot usually therefore be favored in respect of



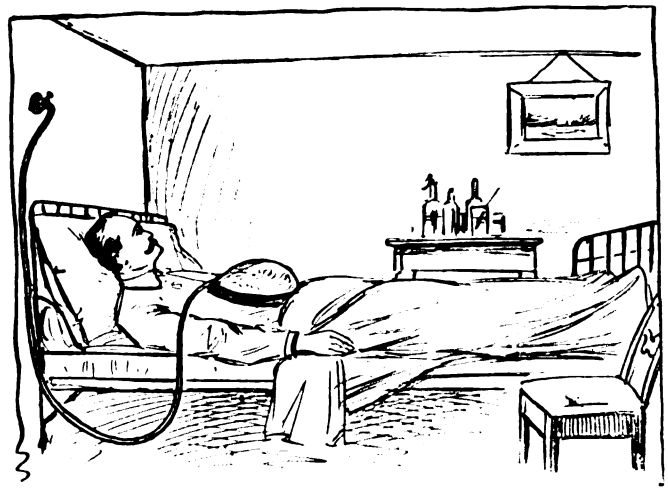
these remedies. Again, some of the applications require physicians to personally supervise them. But there are directions in which electricity can be made to aid expedition and where it can cater to convenience; and the ideal hospital service is that in which the individual can receive the greatest amount of individual attention.

In no small degree, the heating effects of electric currents are being utilized in this kind of service. The homely but most effective poultice is now made possible by a special device in the shape of an asbestos lined water bag, large or small as occasion may require, covered with heavy flannel. In the walls of the bag are coils of wire so arranged that any temperature of the water may be secured and maintained. The connections for the wires are run to the nearest incandescent socket, and the required temperature is fixed and maintained by means of a thermostat. Sometimes instead of a water bag the poultice is a large compressed sponge with a porous casing, so that moisture can be supplied to the surface. It will be readily seen that such a contrivance as this will be convenient, clean and will not require close attention.

Cooking utensils are used in the same way in the wards for heating water, medicines or food, and for heating bed warmers or appliances used in warming the feet or bodies of patients.

Fans are no longer a luxury in hospitals, and it is not uncommon for patients in public hospitals to have the soothing influence of an electric fan breeze.

In many private hospitals phonographs furnished with musical selections or entertaining recitations are provided for patients



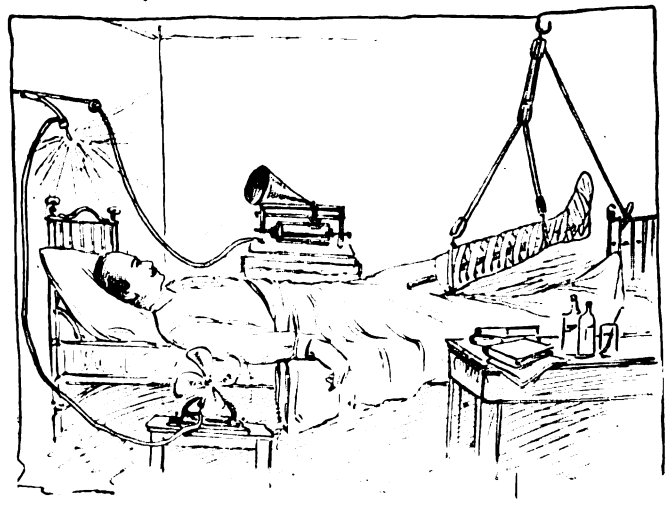
ELECTRICAL POULTICE IN PLACE.

passing through tedious illness or who have undergone surgical operations. No physician or surgeon will fail to appreciate the good effects of mental diversion in such cases.

Local elevators for douche bathing in sunstroke and similar cases have just been introduced in one of the Eastern hospitals, a net swing, a set of pulleys and a small motor being the apparatus used.

It is unique, that while almost every new medical and surgical practice is first introduced into public hospital service, electricity is employed generally in the private practice of nearly all progressive medical men particularly those confining themselves to particular branches of medicine and has not come into common use in the hospitals. This ought not to be the case. The hospitals offer much greater freedom for experimental work and facilities can be better supplied. Whether it is due to failure on the part of the manufacturers to push their wares, or to the other too common feeling that electricity is a luxury to be enjoyed by the wealthy alone, is hardly determinable.

Of course hospital operating rooms are now fitted with appliances for reviving patients suffering from shock or from narcotic poisons. The electro-cautery has almost entirely replaced the thermo-cautery not alone because of its convenience of applica-



PHONOGRAPH AND FAN IN SICK ROOM.

tion, but because the temperature of the cautery knives can be regulated more accurately. Electric drills such as dentists use are being employed for trephining, owing to the ability of the operator to bore gently—and without danger of injuring the brain membranes.

Not an inconsiderable use of electricity is in the detection of malingerers, who feign injury either to secure damages or to get

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into the hospitals. The whole lower half of a patient's body may be paralyzed until an electric current is brought into service. The voluntary muscles and nerves that control them cannot be pursuaded to enter into any conspiracy that may have been set up between the patient's will and his pocket book or his empty stomach, and when called upon properly, will respond, if possible, to a demand from their near relative—the electric current.

Since electricity has become dignified by employment in the service of the ablest men in the medical profession, it will not now be long until all progressive public hospitals are fully equipped with its appliances.

J. Allan Hornsby

ALAS, TO WHAT BASE USES!

Base Ball and Race Horse Indicator is Invented—The Next Thing Will Be Electric Poker.

Within the next few days, the gambling houses that have evaded the mayor and chief of police of Chicago will have a new device in operation that will serve in a measure to take away the poignancy of grief displayed by the sporting fraternity over the closing up of those so-called "racing parks" on the outskirts of the city.

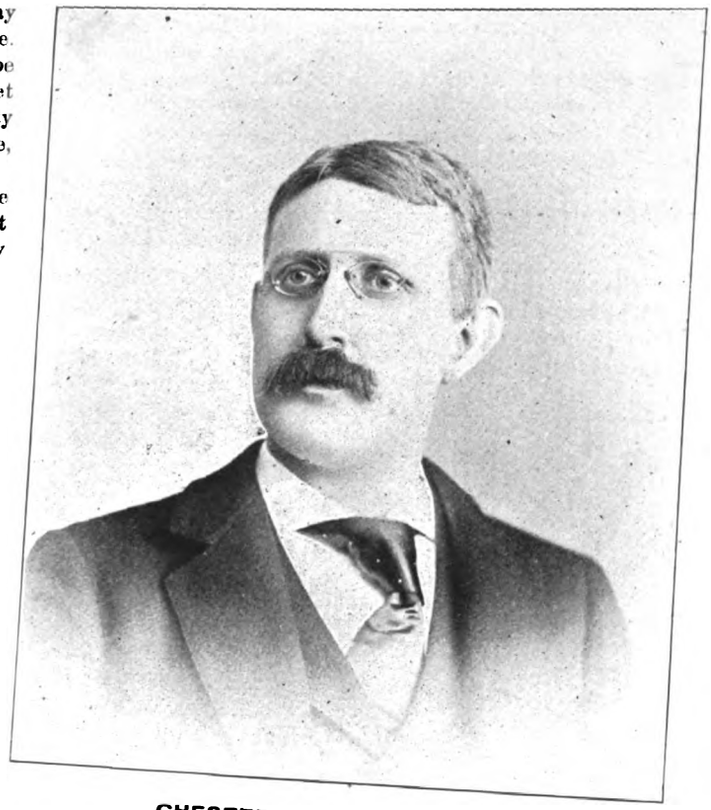
The new device is an indicator that will register electrically the various stages of a base ball game or a horse race.

It consists of a board about forty-two inches high by about thirty inches wide which shows by electricity the moves made in a game of base ball. On the face of the board is mapped out a diamond with the men in position. Small holes are left at each of the bases and the home plate for indicating numbers or pictures. Besides these blank holes or indicators are left labeled "runs," "innings," "hit," "fly," "outs," "balls," "strikes," "home run," "at bat," "called," and "errors." The electrical operation of the board is similar to that of the messenger calls and printing telegraphs. A series of makes and breaks of the current is sent over the single line wire by the transmitter and is caught by an instrument at the board, which sets its indicator into the required position. One transmitting instrument will do for any number of boards, so that one operator in a central office can reproduce a ball game on these boards all over a city.

This indicating device is designed to take the place of base ball returns now received by the so-called "ticker." A number of boards will be set up at various places in the city and connected by wire with the central office. As fast as the telegraphic returns from the ball game come to the operator in the central office he works his transmitting instruments and the game is reproduced wherever a board is located. The number of the man at bat and the runners on the bases are shown, and exactly what the batter does can be seen from the indicators. The total runs from each side and the number of outs in the inning are also shown. These base-ball indicators are manufactured by one of the allied Western Union Telegraph concerns, and are to be operated over the Western Union wires. Companies are now installing the boards in various cities which have league baseball teams, and it is expected a number of them will soon be in use in Chicago. Another indicator for use for race returns is now being built which will show the position of the horses at eight points on the course.

If the new scheme is a success, the inventor will doubtless be called upon to invent the race or the game, and all the elements of a bunko game will be at hand.

"Motorneer" is a word so peculiarly villainous and detestable that it will have no difficulty in securing immediate admission to the language.—*Chicago Tribune.*



CHESTER DELOS CRANDALL.

Chester D. Crandall, general manager of the Western Electric Company, Chicago, was born at Sacketts' Harbor, New York, December 28, 1855. At the age of 19 he left home to enter the College preparatory school at Rochester and a year later entered the Freshman class, of the University of Rochester. He was graduated from this institution with the degree of A.B. in July, 1879. Immediately afterward, he entered the employ of the Western Electric Co., where he has since remained, with the exception of six years which he spent in Kansas City, Mo., as an officer of the Missouri and Kansas Telegraph Company. He was one of the incorporators of that company, and was the first to propose, in 1882, a consolidation of the telephone interests in the States of Missouri and Kansas into one large corporation. Mr. Crandall has served in every department of the Western Electric Company, and his intimate knowledge of the details of the work in all the branches of business in which his company is engaged, makes his service to the company almost invaluable.

Socially Mr. Crandall is one of the most genial and popular of men and has a host of friends, the number being limited only by his acquaintance. He is a member of the Union League Club of Chicago, the American Institute of Electrical Engineers, and the Chevalier Bayard Commandery, Knights Templar.

CHEAP ELECTRICITY.

An invention has been perfected in Hartford, Conn., says the Hartford Times, by which an ordinary coal fire, without the aid of dynamo or battery, will supply all the electric light and power that could be desired in a household. The generator, which resembles a cheap stove, is said to have supplied a 110-volt current for the last three years, operating a pump and running other machinery, and is still as good as new. Five ordinary incandescent lamps, it is stated, are maintained at a cost in consumption of coal of 1c. an hour. The device involves the union of two metals in a multiplication of wedge-shaped bits of alloy, with various appliances to prevent oxidization.

Watts—"I see they are talking of running a trolley line from Jerusalem to Jaffa, or Joppa whichever it is. What do you think of that?" Potts—"I think the good Samaritan will have to ... overtime after the thing gets to going."—*Indianapol...*

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THE WHEATSTONE BRIDGE.

Discussion of the Principle of Ohm's Well Known Law of the Electric Circuit and its Application in the Wheatstone Bridge.

METHOD IN USE FOR MEASURING RESISTANCES.

The manner in which a Wheatstone bridge is manipulated is well known to hundreds of electricians who do not understand the principles involved, and some of whom do not even know the arrangement of the circuits in the instrument. It is the purpose of this article to describe and demonstrate the action of a bridge in such a manner that it may be readily understood by those who have but little knowledge of mathematics or of the laws of electric circuits.

A battery or other source of electric energy establishes a difference of electric pressure between two points. This difference of pressure is measured in *volts* and is called *electromotive force.* In a similar manner a boiler is used to establish a difference of pressure between the gas outside the boiler shell and that within the shell. In this case the difference of pressure is measured in pounds per square inch. No current of steam will flow from the high pressure within the boiler to the low pressure outside, unless some path or opening be made for it. This path or opening will present a resistance to the flow of the steam, else the whole of the pent up steam would escape at once and the difference of pressure would become zero. In a similar manner, no electricity will flow from the high pressure side of a battery to the low pressure side unless some path is provided. If the two electric pressures be connected by a wire a current of electricity will flow from the point of high pressure to that of low pressure. The wire, however, will present a resistance to the flow of this current very much in the same way the orifice in the boiler did to the steam. If the steam escapes through a pipe, the resistance which the pipe presents to the steam will vary with its length and inversely with its size. The same is true of the wire which connects the high and low pressure points of a battery. The longer it is and the thinner it is the greater will be its resistance and the less the current which will flow. It is also evident in the case of the boiler that the greater the difference in pressure on the two sides of the shell, the greater the amount of steam which will flow through a pipe of given size and length. Similarly the greater the difference in pressure between the two battery terminals, or poles, the greater the current which will flow through a wire of given size and length.

We may, therefore, lay it down as a rule that the current which will flow through a conductor will be proportional to the difference of pressure or electromotive force (E. M. F.) between its terminals and inversely proportional to its resistance. Or, if proper units be adopted the current will be equal to the E. M. F. divided by the resistance. This may be written $C = \frac{E}{R}$ and is known as Ohm's law.

We have already said that E. M. F. is measured in volts. Resistance is measured in ohms and current in amperes. If, therefore, we have a wire the resistance of which is 1 ohm and at the terminals of which there is a difference of pressure (E. M. F.) of one volt, then according to the above law a current of 1 ampere will flow through the wire.

If in a circuit, the resistance remains constant, it will be seen that the current will vary directly with the E. M. F. For example, if the resistance of a wire be 2 ohms and the E. M. F. at its terminals be 2 volts, 1 ampere of current will flow. If the voltage be doubled (4 volts) the current will also be doubled.

If the current passing through a conductor remains constant we see from the formula that the E. M. F. between any two points in the conductor, will be directly proportional to the resistance of the conductor between those two points. If, for example, a current of 2 amperes flows through a wire having a resistance of 10 ohms, the E. M. F. at its terminals will be 20 volts. Between one terminal and the center point of the wire the resistance will be 5 ohms, and the E. M. F. between these two points must therefore be 10 volts.

This principle may be expressed as follows: *Electromotive force falls off in proportion to resistance passed over.*

This may be further illustrated by means of a water analogy. Suppose we have a horizontal pipe (Fig. 1), with water flowing through it under pressure from left to right and that ordinary pressure gauges be inserted at A, B and C. It is evident

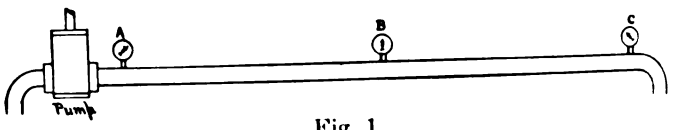

Fig. 1.

that the pressure at A will be greater than that at C, because the friction of the water against the pipe will reduce the pressure at the end away from the pump. Suppose the pressure at A to be 40 pounds per square inch and that at C to be 20 pounds. If B is half way between A and C then we would expect to find it register a pressure of 30 pounds because as much pressure would be lost between A and B as between B and C, the distances, and therefore the resistances being the same. Or the pressure of water flowing in a uniform pipe varies with the distance from the high pressure point, or in other words with the resistance of the pipe.

We are now prepared to discuss the Wheatstone bridge. By means of this instrument three known resistances and the one which is to be measured are arranged so that their values form the four quantities of a proportion. Three of these being known, the value of the fourth is easily obtained by the well known "rule of three," or as more commonly expressed, "the product of the means equals the product of the extremes." The circuits of a bridge are shown diagrammatically in Fig. 2.

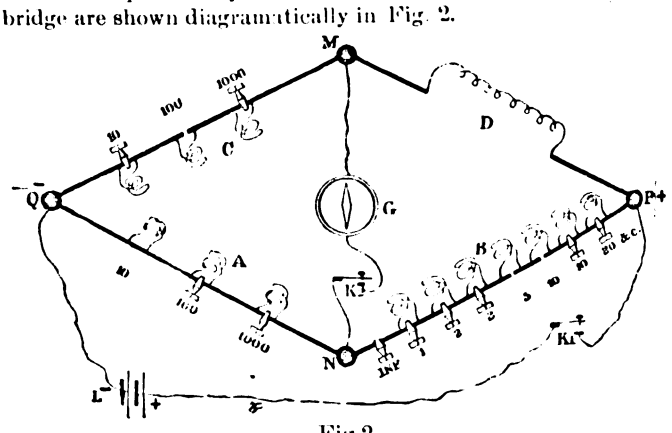

Fig 2.

A, B and C represent three sets of known resistances and D is the resistance to be measured. These four resistances are connected all in series as shown, with a galvanometer, G, and a battery L, connected at the alternate connecting points M, N and P, Q. When the battery circuit key K_1 is closed (the galvanometer key K_2 being left open) a current will flow from the + side of the battery L, to the point P. There it will divide, a part flowing through the upper circuit and a part through the lower circuit to the point Q, where they will unite and return to the — side of the battery. Between the points P and Q in each branch there will be a fall in E. M. F. in proportion to the resistance passed over.

If the fall in pressure from P to M is equal to that from P to N, then M and N will be at the same pressure and no current will flow through the galvanometer G when the key K_2 is closed. If the fall in pressure from P to M is less than from P to N then M will be at a higher pressure than N and a current will flow down through the galvanometer circuit when the key is closed, and again if the point N is at a higher pressure than M a current will flow up through the galvanometer when the key is closed.

To demonstrate this by means of a specific example, suppose

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A, B and C to be plugged to 10 ohms each, and suppose the resistance D to be 10 ohms also; then the circuit P M Q will have a total resistance of 20 ohms, as will also the circuit P N Q. In each circuit one-half the resistance lies between P and the galvanometer terminal, and therefore one-half the E. M. F. between P and Q is lost in each circuit between P and the galvanometer terminal, which makes M and N at the same pressure. If, for instance, P is 2 volts higher than Q, M will be 1 volt lower than P, because it is half way (with respect to resistance) from P to Q. Similarly N will be 1 volt lower than P and M and N will consequently be at the same pressure, and no current will flow through the galvanometer when the key K_2 is closed.

Suppose again that A is plugged to 10 ohms, C to 100 ohms and B to 20 ohms, and suppose D to have a resistance of 200 ohms. Then the resistance of the P M Q will be 300 ohms and that of P N Q, 30 ohms. In the former circuit two-thirds of the resistance lies between P and M and one-third between M and Q (200 and 100 being $\frac{2}{3}$ and $\frac{1}{3}$ respectively of 300). Similarly in the circuit P N Q two-thirds of the resistance lies between P and N and the other third between N and Q. Therefore in each circuit the pressure at the galvanometer terminal will be two-thirds of the whole pressure lower than P, and M and N will consequently be at the same pressure and no current will flow through G when the key is closed. If D is less than 200 ohms, less than two-thirds the pressure will be dropped between P and M, and M will consequently be higher than N and a current will flow down through the galvanometer. And if D is more than 200 ohms M will be more than two-thirds of the pressure below P, and a current will therefore flow up through the galvanometer.

From the figures adopted it will be seen that a definite relation exists between A, B, C and D. This relation is easiest expressed as a proportion, A : C :: B : D or, 10 is to 100 as 20 is to 200. Taking the first three as known to find the fourth we have according to the "rule of three" $\frac{100 \times 20}{10} = 200$, the resistance to be measured. The general rule for operating a bridge is to connect the unknown resistance to the proper binding posts, plug the resistances in the arms A and C (called the ratio arms) to the desired ratio, and then plug B until no deflection of the galvanometer is obtained, when both the battery and galvanometer keys are closed. Then the unknown resistance will equal the product of the resistances B and C divided by the resistance A.

A water analogy may assist somewhat in making the principle of the bridge clear. Suppose we have a system of supply pipes in the streets of a town arranged as shown in Fig. 3.

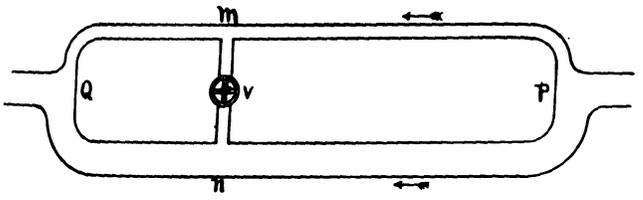

Fig. 3.

Let the water flow from P towards Q in both pipes. Let the pressure at P be 40 pounds per square inch and that at Q, 10 pounds per square inch. Then the difference in pressure between these two points is 30 pounds, and the loss or fall is due to the resistance which both pipes present to the flow of the water. Let the point M be two-thirds the way from P to Q in the small pipe and N, two-thirds the way from P to Q in the large pipe.

It is evident that the fall in pressure occurs in both pipes irrespective of the amount of water they carry. The water in both is at the same pressure at P and also at Q, and therefore the fall in pressure must be the same in both. We would therefore expect to find the pressure at M 20 pounds per square inch because it is two-thirds the way from P to Q and therefore two-thirds the difference in pressure (or 20 pounds) would be lost.

Similarly the pressure at N will be 20 pounds per square inch less than that at P, or would be 20 pounds. Therefore, if M and N were connected by a pipe having a valve, V, in it, no water would flow through this pipe when the valve was opened, although the pipe would be filled with water. If, however, the point M were nearer P than has been supposed then the pressure at M would be higher than at N and water would then flow from M to N. Similarly if M were less than one-third the distance from Q to P the pressure would be less there than at N and water would flow from N to M when V was opened.

In portable testing sets the circuits are not arranged in the form of a diamond but the connections are the same as those shown in the diagram, Fig. 2. A common form of portable bridge is shown in Fig. 4 and another in Fig. 5.

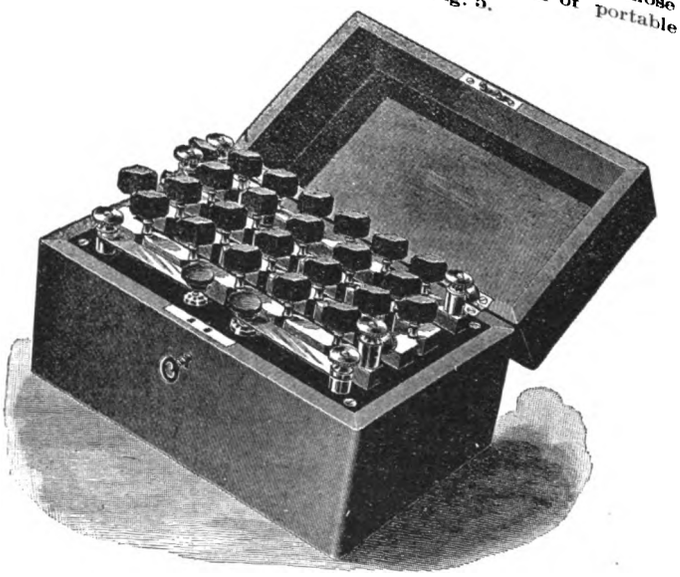

Fig. 4.

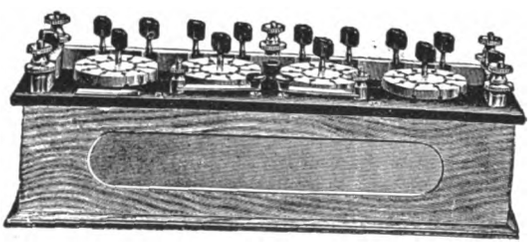

Fig. 5.

Still other forms are made which are in some respects handier than those illustrated, but the arrangement of circuits and the method of calculating the unknown resistance is the same in all.

H. G. BROWNELL, C. E.

ELECTRIC TROLLEY FREIGHT CARS.

A new departure is about to be made by an influential railroad company, which will be watched with the greatest interest by every railroad corporation in the country, says the St. Louis "Globe Democrat." The company proposes not only to install electric passenger cars on many of the "feeders" to its trunk lines, which at present are run by steam, but to place in regular use a service of electric freight cars specially built for the transportation of grain. The cars are to be lighter than the ordinary freight cars, but much more durable. Each car will carry a set of buckets, by which the loading and unloading will be done electrically. It is proposed by means of these cars to make the work of shipping and unshipping much less tedious and expensive than it is at present. The cars can be backed into an elevator switch and be handled without any trouble or delay. A well-known railroad magnate prophesies that within two years nearly all the grain from the great grain belt of the Northwest will be carried into Minneapolis, its center, by electric cars.

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SKETCH OF THE TELEPHONE.

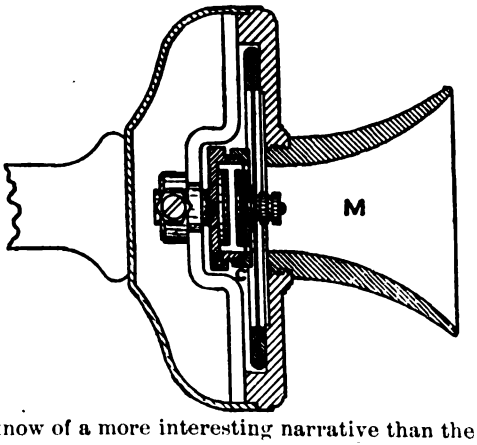
Process of Evolution from the Crude Mechanism of Nineteen Years Ago to the Perfected Instrument In Use To-day.

FUNDAMENTAL PRINCIPLES UNCHANGED.

Edward Bulwer, Lord Lytton, in his clever satire on the manners and customs of his day, "The Coming Race," draws an extremely ingenious picture, with a fascinating air of probability, of what our descendents will be able to accomplish in the subjugation of the forces of nature to their service. The story is read today, when the immediate motive of the book has been long since forgotten, as an amusing tale of Jules Vernesque adventure, if one may be permitted to coin a term.

But since Lord Lytton laid down his pen, an invention has been made by one of us ordinary mortals which this highly imaginative writer did not dare think of. Indeed it would have seemed too grossly improbable even for a creative fancy capable of describing the universal psycho-physical powers of "will." In the story the fortunate member of the "Coming Race" possessed, we are told an ingenious telegraph system, but —no telephone. It was reserved for a practical young man, dealing with scientific facts and working for a specific result in a logical way, to give us this wonderful device.

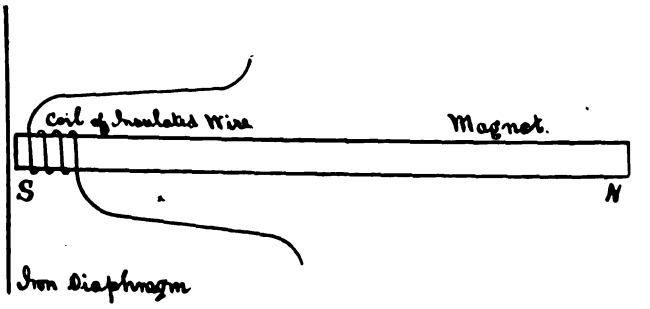
Alexander Graham Bell's telephone, gradually but rapidly evolved by this inventor from the first crude instrument exhibited to Lord Kelvin, at the Centennial of 1876, into a highly efficient form almost precisely similar to that in use as a receiver today is of the kind known as the "magneto telephone."



I do not know of a more interesting narrative than the account of Professor Bell's experiments. Even a person of no electrical knowledge, ever so little interested in mechanical matters must read the story of the systematic unfolding of this wonderful instrument with absorbing interest. Bell's solution of the great problem that had been the dream of scientific men since Philip Reis' abortive attempt in 1861, appeared when first published so perfectly simple that the only wonder seemed that it had not been thought of before. The electrical phenomena which were brought into play in the operation of the new instrument were sufficiently known years before; dating back, indeed, to the researches of Faraday and Henry in magneto electricity and electro-magnetism. The great credit due Professor Bell is for his ability to combine known facts in acoustics and electricity into a harmonious whole, so as to produce what Reis signally failed to produce—a true articulating telephone.

The instrument as it left the inventor's hand consisted of three essential parts--the magnet, the coil of insulated wire wound around it, and the iron diaphragm supported so that it might vibrate freely in front of the pole of the magnet as shown in Fig. 1. Many are the changes that have been attempted on this simple combination, but all subsequent inventions in this class of telephone that have survived the tests of use and time, differ only in details of arrangement from the original "Hand Telephone," which holds its own in this country as the standard. It is found today in use as the receiver of nearly every telephone set on this continent, after seventeen years of continuous effort on the part of inventors to improve it.

The magneto telephone shown in Fig. 1 is both a transmitter and receiver. Its articulation as a transmitter is an almost perfect reproduction of the voice in everything but loudness. The finest, most delicate modulations of expression and *timbre* are startlingly reproduced at the distant end of the line. In good quality—as this fidelity of reproduction is called by telephone men—this instrument always has been superior to the best battery, or microphone transmitter.



It was the lack of loudness of transmission obtained from Bell's instrument that necessitated another invention before the telephone could become the commercial factor that it is today. A few miles of telegraph line under practical conditions, was the limiting distance through which the hand telephone could be made to talk; with the invention of the microphone transmitter following Mr. Hughes' experiments on "loose contacts" or variable resistances in a circuit containing a telephone and a battery, the magneto telephone was henceforth restricted, at least on lines of more than a few miles in length, to use as a receiver only. But it is to be noted in this connection that the lines of today, both telephone and telegraph are vastly superior and better adapted to the conditions of good service than those thought good enough fifteen years ago. Then, such things as "metallic circuits" and the use of copper —to any extent, instead of iron wires, were absolutely unheard of. With the beginning of electrical engineering as a special branch of applied science consequent on the electrical inventions which were being made in rapid succession at that period, came the necessity for more careful construction of lines, as well as of apparatus, in order to obtain the best results under given conditions. Thus it is now quite possible to talk over a distance of 300 miles and further, using a hand telephone as transmitter, because the line used for such a test would be a metallic circuit of copper wire carefully jointed and insulated, instead of the single rusty iron wire full of poorly made joints which the telegraph fraternity managed to get along with in the earlier history of the science.

To confine the subject to the principles of operation of the telephone itself independent of the other details of its commercial operation, we may start by saying that the microphone transmitter was found a necessity in order to transform the telephone from a pleasing scientific toy to a potent factor in modern industrial and social life. The essential parts of the "magneto telephone" working either as transmitter or receiver, have been already described. Its operation as a transmitter may be compared to that of a certain type of alternating current dynamo machine. The voice of the person speaking into the mouthpiece sets the iron diaphragm into vibration corresponding to the sounds uttered, according to a property possessed by their resilient plates, well known in acoustics, of being set in sympathetic vibration by sounds varying through a wide range of pitch. The diaphragm, confined at the edges, moves back and forth in the middle in the same manner as the head of a drum, the number of vibrations per second corresponding to the pitch of the sound

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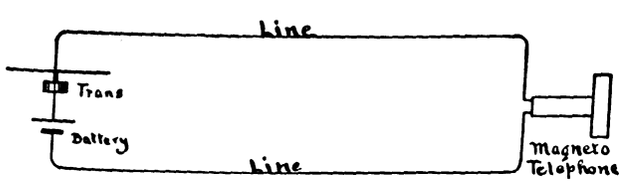
and in so doing *drags with it*—so to speak—a portion of the bundle of "lines of force" which modern scientific hypothesis imagines as emerging from every magnet at its poles. Many of these imaginary lines pass from the pole of the magnet to the diaphragm through the coil of wire which is wound over the pole, and their movement back and forth with the diaphragm, generates electromotive force in the coil—according to a well-known law of magneto electricity—which must correspond more or less closely with the vibration of the diaphragm, i. e., of the voice itself. If, now, the telephone is connected by wires with the coil of another similar telephone, the electromotive force generated in the transmitter will cause corresponding currents to flow over the line and through the coil of the second telephone. Here the above described series of transactions is reversed. The currents arriving from the transmitter may be regarded as acting to strengthen or weaken the magnet over which the receiving coil is wound, alternately, and these variations in the strength of the magnet mean a varying attraction upon its diaphragm, which thus has imparted to its vibrations corresponding, through the chain of operation described, to those of the voice speaking into the transmitter. Thus the voice is *reproduced* at the distant end of the line.

But in the double series of transformation, there is a great loss of energy, so that the tones as reproduced in the receiving telephone are very faint as compared with the original voice. The microphone transmitter overcomes this difficulty by reason of the fact that the telephone current is not produced by electro-motive force *generated* in the transmitter, as in the action just described, but is derived from a battery connected with it. In other words, taking the simple case of a circuit containing a microphone, battery and receiver (but no induction coil) as in figure 2, a strong current is always available for operating the receiver at the distant end of the line, and the transmitter has merely to regulate the flow of this current according to the vibrations of the voice. Thus, the difference between the magnet and the microphone transmitter is analogous to that between a *pump* and a *valve;* the advantage of the latter being that it is not to *create*, but only to *control* the currents resulting from a pressure in the pipe derived from an independent source, e. g.; a water tower giving a considerable head or pressure of water. The best transmitter today, used for long distance service in this country as shown in section in figure 3, consists of a diaphragm of iron or aluminum suitably mounted, to the middle of which is screwed a plate of carbon forming one wall of a little chamber (in which it is free to move piston-wise) containing a small quantity of fine carbon granules. The opposite wall of this chamber is also of carbon,



so that if wires from a battery are connected to each of the two carbon plates, the current will flow from one plate, or "electrode," as it is called, through the mass of carbon granules to the other. As the first electrode is free to move in the cell but is rigidly secured in the center of the diaphragm, any vibration of the latter will cause a variation in the pressure of this electrode on the carbon granules contained in the chamber. This disturbance of the loose mass of carbon causes its electrical resistance to vary correspondingly, so that the strength of current flowing through the transmitter will vary in close accordance with the back and forth movement of the diaphragm. Thus if the transmitter and battery are connected through a line to a distant magneto telephone, the vibrations set up in the diaphragm of the transmitter by the voice will be reproduced in the line as corresponding vibrations, or "surgings of current," which passing through the coil of the receiver, will, by varying the strength of its magnet, cause its diaphragm to reproduce the original sounds. It is evident, that as the battery can be made as strong as need be, the loudness of the transmission can be increased to a very great extent over that to be obtained from a magneto transmitter. In actual use for exchange work, the transmitter and battery are not connected directly to the line, but an induction coil is interposed. As an illustration of the fact that the carbon transmitter is essentially a valve, as already stated, and that its power as a transmitter may be indefinitely increased, apparatus has been made by means of which the volume of sound from the receiver was increased to many times the volume of the original voice; so that a person speaking in an ordinary conversational tone into its transmitter would cause the receiver to shout so as to fill a large hall.

So much for the principles of operation of the modern telephone itself, not touching on the highly important matters concerned in the actual working of exchanges and lines, such as switchboards, protection of apparatus against lightning and abnormal currents, methods of operating, best arrangement of apparatus, etc. A word, however, in regard to the effects of line conditions on transmission: it was early observed that a phenomenon called electrostatic capacity, which produces effects of a certain magnitude for every line according to its various characteristics, had a much more serious effect in weakening transmission than mere electrical resistance. This capacity in a metallic circuit increases proportionally with the length of the line, and is much greater where the two wires are run close together as in submarine and underground cables than in pole lines where the wires are further apart. It is also determined by the nature of the medium between the wires i. e., whether air or some insulating compound, and by the size of the wires themselves. These considerations make it clear at once that it is much more difficult to talk through one mile of cable than many miles of open pole line; and they also act to set a limit to the distance to which one can talk under given conditions. An illustration of this is the impracticability, for the present at least, of operating a telephone by cable from Europe to America. Computations from observed results on long land lines, as well as calculations based on telephone theory, in regard to the combined effect in weakening transmission of combined capacity and resistance of line, show an Atlantic cable (without artificial self-induction) through which it would be possible to talk would require a "wire" of copper as large as a man's leg surrounded by insulating material—the dielectric—to the diameter of a hogshead.

J. B. Baker.

ELECTRICITY ON THE FARM.

The Toronto Globe in referring to the invention of an electric weed-killer, says:

"At present it is intended to apply this invention only to the destruction of weeds along railway tracks, but we may yet see it developed for use upon the farm. Our imagination carries us still further. Why not destroy by electricity the potato bug, the grass-hopper, the canker worm, the red humped apple tree caterpillar, the current stem girdler, and all the other insect pests that war against the farmer? What is the matter with an Electric Bug-Pursuer, having the form and semblance of the obnoxious bug, but charged with electricity, according to the strength of the insect which it is intended to destroy? The false bug would then be let loose in the field, would proceed to gain the confidence of the genuine bugs, engage them in conversation on the subject of new opportunities for depredation, and then treacherously do them to death. It appears that this plan would be safer than Paris green, and less tedious than pressure between finger and thumb. Think, again, of the comfort of an electric mosquito, ready at all times to meet the fiercest champion of New Jersey in battle, with a louder warcry and a deadlier sting.

Horse shoers are the latest accession to the tribe of discontents. They say that the substitution of electricity for horses has nearly ruined their business. Why don't they get into the bandwagon as it were. Good blacksmiths are needed in every machine shop and electrical factory.

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

VOL. I. CHICAGO, JUNE 15, 1895. NO. 2.

Soap grease and sausage are calling loudly for the street car horse.

Electricity as a curative agent is outgrowing the stigma of Charlatanry which formerly attached to it.

Copper wire and wheat are in the same balloon. Has the Hessian fly destroyed the copper crop too?

Copper mines are working night and day to supply the demand. Who said hard times were not over?

Does lightning kill more people than it used to, or have the newspaper correspondents more vivid and picturesque imaginations?

A department devoted to the interests of electro-therapeutics will be a continuous and growing feature of THE ELECTRICAL JOURNAL.

Apropos of motormen:—More money in wages and shorter hours of work would mean strong bodies, clear minds, and—fewer damage suits.

Scientists are busy discussing the chemical composition of the "mantle" of the Welsbach lamp. For our part, we think it is made of shroud cloth.

We spoke too hastily. The Armours and some other board of trade bulls have broken into the electrical field by way of the trolley road. Call the dogs!

Mankind will be avenged if we can but match the deadly trolley "juggernaut," against the new woman female cyclist "juggernaut," for a trial of prowess.

Dr. Wellington Adams' rent must be falling due. He announces another bond issue. Those who think the doctor's inventions are visionary are mistaken.

Now that the silver craze is on the wane, we shall raise our melodious voice in a demand for the free coinage of copper into wire and other things—Why not?

The man who jumped from the Brooklyn Bridge a few days ago, must have thought he heard a trolley car coming. That's the way they feel about the trolley in that section.

German scientists are working hard on the development o a new system of electric rapid traction. Why a new one, when they have already developed more "air" lines than they have found use for?

The newspapers of St. Louis are just now telling their readers what the long distance metallic circuit telephone is, in scare head, column length articles. Sensational news like that ought to be broken gently.

If those who still think the hard times are with us, will kneel down low and put their good ear close to the ground, they will hear some perplexing sounds emenating from the machine shops and factories all over the land.

The ways of Providence are not always inscrutable. The "juggernaut" mantle of the "deadly trolley" has fallen upon the female cyclist. The policeman is the victim, and our babies are saved—compensation everywhere.

St. Louis people are to have metallic circuit telephones in a few months, and they will be relieved of the necessity to guess each time they try to talk, whether it is a saw mill or an able bodied Columbia Bottom mosquito at the other end.

The Manhattan plan to adopt electricity as a motive power on its New York elevated road, does'nt move along with that snap and energy that usually characterizes the subtle fluid. Perhaps they are experimenting with the static kind.

To one up a tree and with a good viewall round it looks as though the first one of the big concerns to get down to business and not only *devise but build* a perfect conduit trolley, will have pre-emption rights to some mighty productive property.

Mr. Prompt, Inspector General of Egyptian railroads, has a plan for utilizing the cataract of the Nile for the generation of electric energy enough to work up 190,000 tons of cotton a year, and thus giving employment to 40,000 native workmen. We venture to suggest that he can't be too prompt in so beneficent an undertaking.

The citizens of Syracuse, N. Y., have furnished the council chamber with electric fans, presumably to keep their councilmen cool that they may deliberate calmly and wisely. If some one will only invent a combination fixture by which councilmen can be kept cool and *honest* at the same time, we would rather have its patent right than be the owner of a gold mine.

Central station people are rapidly developing close business traits. The announcement in another column of a new equipment at Fall River, is accompanied by the statement that the plant is intended to furnish light by night and power for manufacturing purposes in the daytime. Capital earning money both day and night is very likely to have a divident balance at the end of the year.

The bill before the Illinois Legislature to prohibit city councils from granting franchises to gas or electric companies until the consent of a majority of the property owners along the proposed routes is secured, seems to indicate a determination on the part of existing gas and electric corporations to spend *one lump sum* on the legislature and thereby save the annual or semi-annual blackmail that is, and has been levied on them by corrupt councils in the shape of "new" gas and electric ordinances.

The building of an electric road between Warren, Girard and Miles, Ohio, has resulted in reduction of fares by the Erie, Pennsylvania, and B. & O. roads to five cents. The three roads run forty-eight trains a day between the towns. Their managers are now trying to solve the question whether it is better to run for a five-cent fare or give up the business. They will, in all probability do both, and lose money into the bargain, as steam roads cannot compete against electric roads in that kind of service.

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The Dividend Question.

Upon careful study it is not surprising that so many electric stations in our smaller cities fail to pay dividends. The dividend question is a serious one with the central station of average size, as is aptly illustrated by the results for 1894 of the electric stations in the state of Massachusetts. In this substantial old state with its thriving manufacturing cities we might expect to find the electric light plants well managed and paying uniformly fair dividends. Unfortunately the case is otherwise. If we except the two great electric light companies in Boston, the average dividends of the electric light companies of the state were less than four and a half per cent. according to the report for 1894, of the Light Commissioners. Even this poor average appears worse on account of the small proportion of all the electric light stations of the state that paid any dividends at all.

In the Western states the conditions are certainly no more satisfactory than in Massachusetts, but as already said, it is really not surprising that many stations do not pay dividends. To properly operate an electric light station of average size (from 300 to 1,000 kilowatts capacity) may not require a high degree of technical knowledge and experience, but it does require ceaseless activity and an enormous amount of good care on the part of the superintendent.

A superintendent who once in awhile allows his station to shut down in the midst of his heaviest load because he failed in foresight or vigilance, is giving his company's dividends to its competitor, the gas company This is an absurd thing to do, but it is not an uncommon occurrence. The superintendent who permits his engines to be supplied with such wet steam that the relief cocks must be continuously open to avoid disaster is inviting a receivership for his company. Examples of the direct result of inactivity on the part of superintendents may be indefinitely multiplied.

The personality of the superintendent has much to do with the running of the station. Because a station is making between 100 and 150 watts for every pound of coal burned is no guarantee that dividends are being earned or that the best results of which the machinery is capable are being gained, and great improvements may often be effected by the exercise of proper vigilance on the part of the superintendent. Careful tests with the steam engine indicator must be made now and then, good sensible records kept of the station output and of the fuel, water and supplies used, in order that any leaks may be discovered and stopped up. The arrangement of most of the older stations, and I regret to say many of the newer ones, has much to do with their wastefulness; and it requires much careful thought and ingenuity on the part of a superintendent to make the best of a poor arrangement, or to satisfactorily improve it with a small expense. When a station is losing forty per cent. of its power between the engine cylinder and the switch board, it is a serious matter; yet this is the case in a great many electric light stations, though the superintendent never discovers it because he makes no tests. A Siemens-Willans direct connected generating set tested in England by Prof. Kennedy a year or more ago showed only twenty-two per cent. loss between the engine cylinders and the switch board at half load and only twelve per cent. at full load. American results which are not far below these are within the knowledge of the writer, and *no central station of average output should be permitted to average more than thirty per cent. loss between the engine cylinder and the switch board.* With the direct connected set spoken of above this would be equivalent to using the plant at an average load of only about one-third its capacity, and even a poorly arranged plant can usually be handled so that at least half load may be averaged on the running machinery. Heavy counter shafts which are operated continuously, are often a source of much lost power, but a careful arrangement of the dynamos in a shaft driven plant usually makes it possible to work during periods of light loads with but little of the shaft running. Direct connection or direct belting is usually more economical, but the losses due to shafting may by proper attention be kept within quite reasonable limits.

The unsuspected losses which occur in the average electric stations between the engine cylinder and the switch board are not all of the losses which may be found, but the others cannot be mentioned now. It is fortunate for the gas companies that their organization is usually better than that of the electric companies, and that they have fewer leaks to watch. In Massachusetts during the year taken for comparison the gas companies paid average dividends about two per cent. higher than those of the electric companies. With proper care the electric companies can be made to do the same. We will recur to this question again.

* * *

World's Fair Lamp Tests.

The World's Fair afforded unusual opportunities for obtaining valuable information of scientific and practical importance, by means of tests of various exhibits, by experienced and impartial men. Such opportunities do not often occur, and it is greatly to be regretted that, with a few exceptions, they were allowed to pass unimproved. It is not necessary to discuss here the reasons why.

Among the few tests made was that of the life and efficiency of the several makes of incandescent lamps exhibited. This test was undertaken under great difficulties by the jury of awards in the Department of Electricity, and was only made possible by the generosity of exhibitors, who loaned the necessary apparatus and machinery, and furnished current for the tests without charge. The report of the results has not yet appeared and we feel that the responsibility for its non-appearance should be placed where it belongs.

The report was completed and filed with the proper authorities about April 1st, 1894, with text and plates ready for the printers and engravers. It was kept in Washington until July, when the authorities, acting on a technicality, refused to pay the small sum earned by the computers of the test, after the close of the Fair, though their employment for the purpose had been approved and directed by one supposed to have authority for so doing. The report was then withdrawn and is now in the hands of those who did the work, where it will remain until the computers are paid. How long this interval will be remains to be seen.

* * *

What Fifty Years Have Brought.

An electric railroad between Baltimore and Washington will be completed and in operation by November of this year. The road will be thirty-two miles long and will have feeders from all the principal towns along the route.

The building of this road recalls more forcibly than any other one thing could, the growth and development of the science of electricity during the past fifty years. In 1842 Prof. Morse and his associates were fighting in Congress for an appropriation of $30,000 with which to build an experimental telegraph line. The proposed route was from Baltimore to Washington. Among the objectors to the scheme were the residents and farmers along the proposed right of way who insisted that such a line would endanger the lives of the people, and kill all the birds. After long conferences and grave head shakings, the board of directors of the Baltimore and Ohio road startled the country by passing a resolution to grant Professor Morse the privilege to run the line over their right of way—with the menacing proviso, however, that at any time, during the progress of the work, they might withdraw the permission in the event

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that the safety of the community and the good of the road demanded such action. Another condition was that the line should be underground.

It was under these conditions that the work was begun. For the first twelve miles—out to Relay Station—the wires were laid underground in lead pipe. No account was taken of insulation, consequently the attempt to telegraph over that twelve miles was a failure. More than eighteen thousand of the thirty thousand dollars had been spent, and all for nothing. One may readily imagine the effect on the public. Another fight, long drawn out, followed, to secure permission to go overhead with the line. We all know the ultimate result.

To-day an overhead wire carrying 500 volts, to operate a road in competition with that very Baltimore & Ohio road of olden time, creates no comment.

* * *

Twelve Miles An Hour Not Excessive.

Judge Carpenter has recently handed down a decision in which he takes the ground that 12 miles an hour is not an excessive rate of speed for an electric road. The Ft. Wayne & Belle Island road had killed a man and damages were asked wholly on the score of excessive speed. The accident occured in the country where there was little travel.

A good deal has been made in the newspapers over this decision, but it is difficult to see how there could be two opinions on the subject. Judge Carpenter has simply shaken himself loose from the witchcraft notion that whatever is associated with the trolley is wrong and ought to be punished. There is no doubt that steam roads might, and do go at the rate of 40 or 50 miles an hour over just such places as the site of this accident. In the case of a steam road, however, the question would have wholly turned on "negligence," and a few more decisions like that of Judge Carpenter will do a good deal to stop the calamity howls of those lawyers who have now no sort of respect for anything electrical; they have come to believe that any jury will find against an electrical company, no matter what the circumstances.

* * *

Will The General Electric Move?

"The General Electric is about to concentrate its whole working force in Harrison, N. J., where the people have donated one hundred acres of land and a million dollars for a bonus."—*An Exchange.*

"The General Electric has about concluded arrangements to move its Schenectady and other works to Niagara, where power can be had for its factory operations, cheaper than elsewhere."—*Another Exchange.*

"A movement that means much for the interests of the city of Schenectady is under way, and is expected to reach a conclusion next week. It is a movement for the consolidation of all the General Electric and Edison Companies, with the object in view to locate them all at Schenectady."—*Still Another Exchange.*

We have been in the secret of the movements of the General Electric people all along, but hesitated to publish their plans. Now that the secret is out, and their final determination known, there seems no occasion for further silence on our part.

* * *

Municipal Lighting in Pennsylvania.

A bill has just passed the legislature of Pennsylvania to prohibit cities and towns from going into the municipal lighting business, until they shall have purchased from the owners any existing private plants that have been engaged in public lighting. This proposition looks as though its originators were either the most guileless and ignorant of public servants, or that the legislature is made up of stock holders of the electric lighting companies. The governor's action on the bill will indicate whether he has any further political ambition. The press and people are up in arms, and threaten vengance on all who so far betray their trust as to vote for what they call a "most iniquitous piece of class legislation." The whole case seems to have resolved itself into a question whether the street railway companies shall divide their ownership of at least the principal cities in the state with the electric lighting companies.

* * *

Memorial Day In Brooklyn.

The attempt on the part of the people of Brooklyn, to excite sympathy by decorating the graves of victims of the trolley, as a part of the Memorial Day exercises, will hardly receive the endorsement of those who have a genuine reverence for the day. There is a time and place for everything, and Memorial Day is set apart in memory of heroes of the Union. Beside, Brooklynites have another remedy for their grievance, than the excitation of a maudlin sentiment. Let them prosecute vigorously, and punish severely those committing the crime of manslaughter, and their ends will be achieved, in a manly and substantial way. If they lived under an absolute monarchy and had not the whole majesty of the law in their own hands, there would be some excuse for their recent inane and weak display.

* * *

Will He Make the Trial?

The press of the country, that is the lay press, is working itself into a hysterical state over the recent statement of George D. Burton, of Boston, that electricity does not kill people, and that if an electrocuted criminal were to be laid on wet earth and saturated with water, all the "electrical fluid could be drawn off," and the supposed dead man restored to life.

The case seems to be a really serious one, worthy of a serious remedy. There have been, in times gone by, men so thoroughly earnest in their search for the truth, as to be willing to attempt a demonstration of their theories on their own persons. That is a favorite practice with medical men.

Mr. Burton has the floor.

* * *

We All Want To Know.

If the editor of the *Electrical Review* will get some good strong, able bodied man as body guard, and go up to Albany, and ask John Boyd Thatcher about those incandescent lamp tests, he will probably learn something to his advantage. Will the genial editor also please ask "the whole ting" how many New York people were given awards over the heads of the jurors. He might also ask while on the mission, when the medals are intended to be distributed. A large number of anxious inquirers will welcome the genial editor's return if he will solve, or secure solutions to a few of the foregoing conundrums. But don't forget the body guard. We have had experience, and speak advisedly.

* * *

Place The Blame Where It Belongs.

The Grand Rapids Electric Companies have expressed the universal sentiment of the electrical fraternity, in their protest against the fire and insurance people announcing every fire not otherwise easily accounted for, to be "due to electricity." This kind of thing ought to be stopped. It has been stopped in Chicago and a few other places and should be everywhere. Every burden put on electricity makes it just that much harder for the business. The insurance people should be made to understand that they will not be allowed to collect blackmail in the shape of increased rates by crying electricity when fire hazards are at issue. A few years ago there were several attempts to institute insurance companies, specially to take electrical risks. The other companies changed their tactics at once, and we have not heard of these special concerns since that time. But the insurance people are willing to use any scheme on earth to squeeze a few extra dollars out of the people, and just now electricity happens to be the best club they have.

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Our Friends Contribute.

Steadily there is an improvement in the financial situation in the electrical industry. The struggle is not over, but courage and carefulness are the chief aids to be relied upon for the full return of profitable business. Many have been too sanguine over the profit-producing abilities of the electrical field in the past and were unfortunate sufferers during the depression now gradually receding from view, we hope never to return. Be careful in your accounts, keeping such risks to the extreme minimum, and have the courage to ask a reasonable profit on goods of first-class quality and make no other. You will then deserve and win success.—*Electrical Review.*

At last the trolley railway system has been put to a use at which even the New York papers cannot cayil. It is now an instrument in spreading the gospel. It appears that on Monday night of last week a party of men and women connected with the Passaic street mission, in Passaic, N. J., chartered an electric car on the New Jersey Electric Railway, and went by way of Paterson to Singac and back. Wherever they saw a group of people on the sidewalks or rural roadsides the car was stopped, and the evangelists sang hymns and exhorted the bystanders to seek salvation. The idea is a novel one, and while it is difficult to see how it could be carried out without interfering with the regular traffic of the line, it is possible that some person might be impelled to better living who could not otherwise be reached. Let the car be run slowly, with fenders to mitigate possible accidents; then invite some of the Brooklyn preachers who have lowered the standard of their calling by sensational and perfervid diatribes against the whole trolley system to find a more useful field for exercising their talents on the gospel car.—*Western Electrician.*

A VAGABOND'S VAGARIES.

Once on the occasion of a celebration of the birth day of Benjamin Franklin, in Philadelphia, a brilliant but too convivial guest was called on for a few words apropos of the occasion. He rose at his place, and began haltingly and in an unsteady voice, an address that lasted half an hour, and which ended as follows:

"The finger of decay may write in dissolving characters the fate of states and empires, but his name is twined around the lighting's wing, and borne to distant climes upon the far-off roll of retreating thunders."

We may have vastly improved upon the knowledge of the ancients regarding electricity, but in doing so we have ruthlessly shattered some beautiful sentiments. That poetic nation, the Phoenicians, believed that the electricity which came from Amber by rubbing, was the reanimated soul of a beautiful virgin, who in life had been so pure and sweet that her benign influence would abide always in behalf of him who was so fortunate as to possess the spirit home she lived in. It was the "Amber soul."

It seems almost a sacrilege to turn a thousand volt current against a sentiment like that.

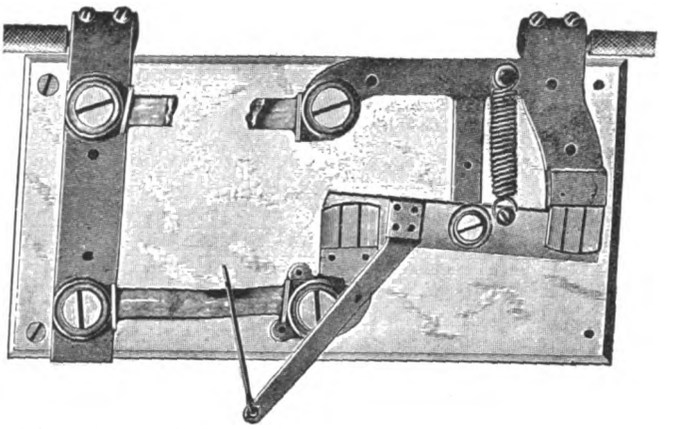
A female cyclist one day
Was feeling unusually gay;
She dashed down the street
Past a fly cop's beat,
And the copper cried warningly, "Heigh!"

For a moment the nerve
Of the cop made her swerve,
Then she gathered her—pants, for the fray:
—When the copper arose
And brushed off his clothes,
The bloomers were a half block away.

But the maid saw her folly
As down came the trolley
Too quick for the cry to be given:
—Hence a new fangled dress
And a motor the less,
But a recherche costume in heaven.

Wagner's Automatic Fuse Cutover,

The trouble often occasioned in the Central Station by the blowing of a fuse is obviated by a device made by the Wagner Electric Mfg. Co., of St. Louis, and called an Automatic Fuse Cutover, illustrated herewith. It is a single-pole cutout, and is so quick in operation that the almost instantaneous waver of the light is not noticed unless the lamps are being watched. It is auto matic in operation, and requires no attention from the one in charge of the apparatus. As will be noticed by reference to the cut, there are two sets of terminals with places for two fuse links, one of which can be cut out of the circuit.



When the fuse links are both in, the upper one holds the lever of the switch bar, throwing the spring into tension. In this manner they will remain until a short circuit occurs on the lines or the fuse becomes impaired and is blown. This releases the bar and the spring throws it into the clips. A new fuse now carries the current in place of the old one. Should the second fuse blow, it is an indication that trouble of a serious nature is on the lines and needs investigation. The new fuse will carry the current if the lines are in proper condition, and will give the attendant time to insert a new fuse in place of the one burned out.

A slight waver in the candle power will be noticed, but aside from that the lights will give no indication of the blowing of the fuse. The reader will undoubtedly recall the trouble that has occurred after a fuse has blown that was not protected by a device of this kind; the search in the dark for wrench or screwdriver and a new fuse and the time consumed before the lines were again in shape.

WILL ELECTRICITY LOCATE IT?

Sometime ago a safe, said to contain about $5,000 was lost in the bay at Tacoma and repeated efforts to find it have been fruitless. Now two local electricians have come to the rescue, says the "Tacoma News," with a scheme which they claim will locate the missing treasure.

The device will be worked with electrical apparatus. Wires will be attached to an annunciator on shore or above the water, and the diver will carry the end of the wires along the bottom with him, and when a large piece of iron or metal is located the fact will instantly be made known to those who watch the indicator.

The electricians will not give the details of their process until they close a contract with the railroad company for the recovery of the safe.

Diver Baldwin has almost given up hope of finding the lost safe on the water front by ordinary methods. He says the bottom of the bay in the vicinity of the landslide is covered with a hard crust from two to ten feet thick. If the safe went through this crust it would be impossible to recover it for the reason that the ground beneath is very soft and similar to quicksand. However, he does not think the safe could have broken through the crust but that it was rolled along the hard surface to some obscure spot and became covered up with mud.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students.

Personal and Pertinent.

A survey of the work of the National School of Electricity for the past year has demonstrated beyond question the good the school is doing in many directions. We shall take the liberty to discuss these various directions from time to time.

For the present we will consider the help that the school has extended to many embryo inventors and developers of machinery. Thers are many things, mechanical in their nature that are incomplete and that will remain so until the aid of electricity is called in to supplement them. Two instanaes of this kind will suffice. About the time the school was organized, a young man joined a class for the purpose as he said of acquiring information that would enable him to carry out some advanced thoughts in railway signalling. Up to that time he had designed a signalling device purely mechanical, but it was imperfect. He thought that possibly if he knew what electricity would do under given conditions he could perfect his device. His judgment in that direction was proven good when a few weeks ago he announced that he had perfected his system. Since that time he has interested capital in his work and bids fair to accomplish his ambition.

The second case is that of a young man who had worked on or about the water all his life, and who had his heart set on designing a life-saving boat that would be more effective in saving life than those in use. He reasoned that much of the inefficiency of life saving crews was due to the fact that they were, as a rule, worn out rowing to the scene of an accident and, when arrived there, could not give their best efforts to the rescuing of the ship wrecked. He thought if he could get life boats to the scene of disaster without taxing the strength of the crew, he would have accomplished a great deal. He had previously done a good deal in life boat designing, and needed only an acceptable motive power. He had eliminated steam and naphtha, consequently he was reduced to the necessity of using electricity. No apparatus hitherto made would do, so he joined the school with a view to learn about electricity, and especially about primary and storage batteries. Whether his ambition is to be realized may not be said—at any rate, he has been able to find some men willing to test his plans, and shortly he will launch an electrically propelled life boat. These are only two cases, but they demonstrate the principle that actuated the school management in providing a system by which at least an elementary knowledge of electricity might be acquired. It is only a few students, perhaps, who go into the study with as well defined notions of what they wanted as these two young men.

In Louisville, Ky., a third class is about to be organized as a direct result of the interest that has been aroused by the two classes already taking the course.

As a result of the work accomplished in the four classes at Minneapolis and St. Paul during the past year, there are enough applicants for membership in the hands of City Electrician Pillsbury, instructor for the class, to form two new classes. The new organizations will be made within the next few days.

The Louisville Railway Class has just completed the electro physics part of the course, and began the study of railway practice last week. The class has been specially fortunate in its instructor, Mr. G. Wilbur Hubley, Electrcal Engineer of the Louisville Electric Light Company, a thoroughly practical man.

Mr. C. B. King, president of the Louisville Railway Class, has been transferred to membership in the Detroit Class. Mr. King has just taken a position with the Detroit Railway Company under A. B. Dupont who recently resigned as Electrical Engineer of the Louisville City Railway Company, to become General Manager of the Detroit Railway Company.

Mr. A. W. Angur, instructor of the Des Moines Class, has been in Chicago during the past few days in consultation with the chief instructor in regard to the conduct of his class. The Des Moines Class while not large, contains some of the brightest men in the school, and undoubtedly before the year is over some good work will be announced from that class.

Mr. William A. Brown of the Fort Wayne class has erected a small laboratory and workshop for the purpose of experimenting with electrical show window displays. He has already installed several fine equipments of revolving lights which change into many artistic tints. Mr. Brown had charge of the electrical display at the recent Trades and Labor Fair, which proved to be one of the finest exhibitions ever seen in that city.

Instructors of the school are reporting most excellent results of the visits of classes to central, isolated and railway stations during the time the classes are studying commercial work. The members are much benefitted, not only by the practical demonstration of actual work at the hands of their instructors, but are being aided much by practical talks on special subjects, by engineers in charge, who are reported as being uniformly courteous and obliging to the classes.

Lewis Searing president of the Denver class and a member of the well known engineering firm of Shepard & Searing, has been appointed Secretary and Treasurer of the Denver Engineering Works, a new corporation organized for the purpose of manufactnring mining, milling and smelting machinery. The new company has bought out the machine shops and foundry of the Overland Machinery Company of Denver, and with the addition of new machinery and appliancss will be well equipped to compete in their line of business.

ELECTRO-THERAPEUTIC CLINICAL LECTURES.

The clinical lectures of the electro-therapeutic classes of the National School of Electricity in Chicago will be given at the Cook County Hospital commencing Tuesday June 18, at 8 o'clock in the evening. The dates, lecturers and subjects are as follows:

June 18th: Dr. Franklin H. Martin, on "Electricity in Minor Gynaecology."

June 21st: Dr. D. R. Brower, on "Applications of the Various Forms of Electricity in Treatment of Diseases of the Nervous System."

June 25th: Dr. Franklin H. Martin, on "Electricity in the Treatment of Fibroids."

June 28th: Dr. D. R. Brower, on "Electricity in the Treatment of Diseases of the Nervous System."

July 2nd: Dr. John B. Murphy, on "Electricity in the Treatment of Surgical Cases."

July 9th: Dr. John B. Murphy, on "Electricity in the Treatment of Surgical Cases."

The lectures will be given in the ampitheatre of the hospital, and through the courtesy of the medical staff access will be had to the necessary clinical material and apparatus for demonstration.

COMMUNICATION.

SAN FRANCISCO, JUNE 10, 895.

National School of Electricity, Chicago, Ill.:

GENTLEMEN:—I am informed that you have published a lecture on the sinusoidal current and I wish to obtain it. Will you be good enough to send me a copy? I am greatly interested in sinusoidal electricity, but have not been able to obtain much literature upon the subject. Can you direct me to any?

Yours very truly,

ERNEST PRING, M. D.

THE ELECTRICAL JOURNAL of July 1 will contain a paper on this subject that will be of general interest to the medical profession.—[Editor.]

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

A telephone line from Mitchell, South Dakota, to Sionx City, Ia., is contemplated.

Providence, R. I., will place its fire alarm and police telegraph wires under ground.

Complaint is made in Chichago that trolley wires interfere with the telephone service.

St. Louis, Mo., will be connected with New York and the East by a long distance telephone before the new year.

The citizens of Lawson, Mo. want telephone communication with Kansas City, and hope to make the necessary arrangements in the near future.

The Iowa Telephone Company is putting in large copper wire between Wapello and Columbus Junction, and will equip the service with the best long distance instruments.

The Harrison Telephone people have organized a corporation to run a telephone exchange at Owensboro, Ky., with a capital of $20,000. Some prominent people are in the new concern.

Some Grand Rapids parties headed by H. H. Foster, have started out to obtain a franchise for a telephone exchange. They announce that their rates will be $30 per year for business houses and $12 for residences.

A war is on between the Central Union Telegraph Company and the new Lima Telephone Company of Lima, Ohio. The new company was compelled to cross the lines of the old company to which objection was made and cutting of lines was begun. The police had to be called in.

At the recent Republican State convention at Zanesville, Ohio, the telephone played an important office. Many newspapers throughout the state, instead of waiting for reports by telegraph, had the news telephoned direct from the convention hall. It saved time.

Telephone exchanges, independent of the Bell Company, are either in operation, or in course of construction in the following Ohio towns: Columbus, Chillicothe, Newark, Mt. Vernon, Washington, Cambridge, Lancaster, St. Mary's, Marysville, Findlay, Delaware, Van Wert, Lima, Wapakoneta, Norwalk, Plain City, Fostoria, Tiffin, Bellefontaine, Zanesville and Massillon.

The Standard Telephone and Electric Company of Madison, Wis., began operations this week. It will manufacture telephones for sale outright and in addition will operate an exchange in Madison. The rates will be $1.50 per month for residences and $2 for business houses. The company starts business with an order for 600 instruments from the Home Telephone Company, of Sioux City, Iowa.

The directors of the American Bell Telephone Company declared a regular quarterly dividend of three per cent. and an extra dividend of one and a half per cent, payable July 15, to stock of record June 25. The directors voted to call a stockholders' meeting June 24 to vote an increase of capital stock and recommend that the stockholders vote an increase of $1,000,000 of capital stock, or 10,000 shares.

The Press of Utica, N. Y., in commenting upon the device of a Syracuse man which will do away with the central station telephone girl, remarks that: "If the device is successful it will materially reduce profanity, and in that respect will be a blessing to the race both here and hereafter." This is the first instance that has come under our notice where the telephone girl was charged with using profane language.

The Citizens' Telephone Co. of Quincy, Ill. will ask for an extension of time to begin operations. The franchise they were granted by the council stipulated that they should build their plant within two years from the passage of the ordinance. The two years are now nearly up and there has been nothing done. This is on account of the inability of the company to find a thoroughly reliable system which was not an infringement on existing patents. The managers of the company are confident that the people of Quincy will patronize them, and they are still desirous of putting in an exchange. As it will be manifestly impossible to do this before the expiration of the time set in the ordinance an extension of time will be asked for.

Light and Power.

An effort is being made to organize a new electric lighting and power company in Indianapolis, Ind. A reduction of 25 per cent. in present rates is promised.

The officials of the electric light company in Washington, D. C., cut off the lights from Butler's Bijou Theater one night recently in the middle of a performance, because a past due bill had not been settled.

The Columbus (Ohio) Electric Light and Power Company has secured a twenty-five year franchise after a six months' struggle. A proposition to tax the company upon its gross receipts was defeated in the city council.

The Jenney Electric Motor Company of Indianapolis, has built and shipped to J. B. Clow & Co. pipe manufacturers, New Comerstown, a two hundred and fifty horse power generator. The machine weighs 30,000 pounds.

The Brazil Block Coal Company of Brazil, Indiana, will hereafter mine coal by electricity, and will illuminate the entire mine with electric light. One electric machine will mine thirty-five tons of coal a day, equivalent to the work of twelve skilled miners by the old process.

Springfield, Ill., owns and operates its own electric light plant. Rates have been reduced from $138 to $113. In five years time it is figured that enough will be earned over and above the cost of production to pay for the plant and then the charge will be reduced to $60, which is said to be the cost price.

The city of Springfield, Mo., is figuring on a proposition to do its own lighting. Some of the councilmen have told the people that are lamps of 2,000 candle power can be supplied for $50 a year, including every expense. The people will have a vote to determine whether they believe that figures won't lie.

A bill was recently passed by the legislature of Pennsylvania, and is now in the hands of the Governor, which provides that municipalities desiring to operate their own lighting stations, must first purchase the plants of the companies at present operating in their respective localities. Pressure is being brought to bear upon the Governor to veto the bill.

The electric companies of Grand Rapids, Mich, have entered a protest to the fire commissioners of that town against the unwarranted practice of attributing fires to electric light wires when the actual cause is unknown. They claim that their business is being injured and demand that only upon investigation and positive proof should such statements be made.

The Lachine Rapids and Hydraulic Company, Limited, organized to utilize the Lachine Rapids water power in generating electricity to drive factories at Montreal, have advanced their scheme another stage by calling for tenders for the coustruction of the proposed work. The tenders are to be in by the 20th of June. The company expects to produce electrical power equivalent to 8,000 horse power.

The Fall River Electric Company of Fall River, Mass., is to install a complete system of monocyclic apparatus. Two 75 kilowatt generators will be used and the output will be used for lighting purposes during the dark hours, supplying current during the day for general power work. The motors will be of the

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General Electric induction type, ranging from one to ten horse power, and will be wound for 110 volts, to which pressure the current generated at 200 volts will be rendered.

The Oakland Gas and Electric Company, of Oakland, Cal., will use a three-phase transmission plant for general power work. Current to a number of induction motors ranging from one to fifteen horse power will be supplied from a 75 kilowatt three-phase machine, and there will be extensive lighting in connection with the plant. The generator current at 2,000 volts will be reduced at two centers of distribution to the necessary potential, and the secondary net work will cover a territory of 1,200 feet in every direction from both centers. From these points pressure wires will be run back to the power house, and the voltage will there be controlled by potential regulators.

Railways.

The Louisville City Railway Company will run several new extensions this summer.

Miss Marguerite Maidhof, of New York City, has invented a fender for use on electric cars.

It is said that the Westinghouse people have solved to their satisfaction the question of electric traction, and that the solution is—a conduit trolley perfect in all details.

In Montreal a complaint has been lodged against the Electric Street Railway Company because of the noise made by their cars, which is attributed to defective wheels.

Double deck electric cars are in practical operation in Paris, the motive power being furnished by storage batteries instead of through the trolley. In place of gongs to give warning of their approach, a horn is used and is operated by pressing a rubber bulb.

The Vanderbilt lines of railroad in New York are arranging to substitue electricity for steam as a motive power, and with a view to this change water power rights along the line of road are being acquired so that the current can be produced at a minimum cost.

Clark street in Chicago is one of the busiest thoroughfares in the country, but many of the merchants doing business there are eager for a change from horse car to electric service. They prefer an underground trolley but will agree to anything to do away with the horse cars.

The New York Central Railroad Company is experimenting with storage battery cars for the purpose of equipping their line between the terminus of the Sixth Avenue "L" road at 155th street, New York, and Yonkers. The road at present is operated by steam.

The Alley "L" road in Chicago is contemplating a change from steam to electricity. The expense incurred in erecting the necessary buildings for the power plant, the extra rail and the dynamos and motors would be about $500,000, but the saving in coal would be a very large item as an offset.

The General Electric Company is said to be a large stock holder in the newly organized Little Rock, Ark., street railroads. Of $500,000 capital, the General Electric and United States companies hold $400,000 of stock. The receivers have released the property into the hands of the new company.

President Roberts and other officials of the Pennsylvania railroad have been experimenting with electricity with a view to adopting it as a motive power on their line between Philadelphia and Atlantic City. Cars will be equipped with 75 horse power motors, and it is believed a speed of sixty miles an hour can be maintained without difficulty or danger.

Electrically equipped engines are now operating in the Baltimore & Ohio's belt line tunnel in Baltimore, Md. These new engines will demonstrate their ability to do good service by hauling the heavy Philadelphia and New York express trains and long freight trains through the tunnel. If the experiment proves to be a success similar engines will be placed on the road for general work.

The Pennsylvania Railroad Company is fighting in the courts several electric roads that propose to enter into competition with them on passenger service between towns. The basis of the action is that the charters of the electric roads provide only for local service. They are opposing also the crossing of their tracks at surface level. If they succeed in maintaining their contention it will virtually mean the death of the electric lines.

The Kansas City and Independence Rapid Transit railway, operating between Kansas City and Independence, Mo., will substitute electricity for the "dummies" formerly in use. New double truck upholstered Pullman cars will be used capable of accommodating 120 people comfortably and in a rush 140 people. Each car will have a smoking compartment and will be lighted by fifteen incandescent lamps and is geared to a speed of thirty-two miles per hour.

Receiver Payne of the Milwaukee Street Railway, has brought order out of chaos very quickly after taking hold as receiver. The impossible conditions under which the roads have been operating will be relieved by the bondholders agreeing to take 37½ per cent. of their bond-holdings in preferred stock. This will enable the bondholders to get all there is in the property and at the same time reduce fixed charges to an amount which the property can bear. In order to provide new capital for construction purposes $1,000,000 new bonds and $1,000,000 new preferred stock will be issued. By surrendering the proposed percentage of their holding the bondholders will reduce the bonded indebtedness of the company over $2,000,000, even after the new issue is added to those already outstanding. This means a reduction in fixed charges of at least $100,000 per annum.

There is a difference between working for a court, and for warring factions of interested parties, as Receiver Payne has evidently ascertained.

General News.

Philadelphia is rapidly getting its wires underground.

The present monthly pay roll of the Fort Wayne Electric Corporation aggregates upwards of $25,000.

The Siemens & Halske Electric Company of America was granted an increase in capital stock from $1,000,000 to $2,000,000.

The people and authorities of Maryland are agitating the substitution of the electric chair for the rope for the execution of criminals.

There were in the City of Chicago during the year ending April 30, 1895, 6,659 fire alarms, or an average of one call for the fire department every hour and twenty minutes, day and night. Of these fire calls, only thirty-eight were what is known as 4-11 calls, which summon the whole department.

The Washington authorities in the Naval Department are testing some new devices for closing hatchways by electricity. The disaster, not long ago, to the British battleship Victoria, was caused by the failure to close the air-tight compartments when the collision came. The tests now going on contemplate a system of electric door closers, worked from the conning tower by a lever, so that instantaneously, on occasion, all hatch ways and compartments can be closed simultaneously.

General Custer of the Union Army, and General T. L. Rosser of the Confederate Army had both reached the rank of Major General before they were twenty-three years of age. It was during the driving times of '63 and '64, after the older men had found the pace to hard to hold. There are more very young men at the front in the electrical business than in any other industry. Hundreds of electrical patents have been granted to boys in their teens.

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WILL JULES VERNE PLEASE COME FORWARD.

United States Fish Commission Lights the Sea Eight Hundred Feet Below the Surface—Fishing for Monsters Five Miles Down.

Few people catch fish at a depth of 800 feet. There are fewer fishermen at a depth of 4,500 fathoms, or 27,000 feet. Uncle Sam is the only angler in the world who insists on such deep sea fishing, and measures depths, not by hundreds of feet, but by miles. He has a boat built specially for the purpose. This vessel, the United States Fish Commission steamer Albatross, comes into San Diego Harbor frequently, and is an object of rare interest to the landsman.

The Albatross is strictly a scientific fishing craft. She cost over $100,000, is 234 feet long, and of 1,074 tons displacement, with a brigantine rig. Her business is to follow ocean fish as they migrate from their summer to their winter home, and observe their manner of life. This work includes the collection of fish, mud, and shells from a depth of 27,000 feet to the surface. The ingenuity of the scientists and navigators has resorted to the employment of the electric light at great depths in order to attract heretofore unknown and otherwise unobtainable fish into the trawl which is let down from the ship's side.

In this way small fish are usually caught. Sometimes when the electric light is near the surface of the ocean large fish are attracted by the illumination. The light seems to make the big fish angry. Sharks, for instance, will dart at the light as if it were a deadly foe.

The light is sometimes lowered 800 feet from the surface. At a depth of seventy feet the illumination becomes invisible. When the light is twenty or thirty feet down, and huge fish congregate about it, their shadows are cast upward on the surface of the sea, and from the deck of the ship the scene is weird, indeed. It is a veritable congress of monsters of the deep that sometimes gathers about what to them is a wonderful sight. An electric lighted submarine home is something novel even to a tough old shark.

It has been noted that the effect of the electric light upon the big fish has been such that as deadly enemies as the shark and the swordfish will swim up to the light side by side, and so amazed are they by the wonderful shining bulb that they appear to forget the deadly feud existing between their piscatorial families, and they do not rush at each other in mortal combat. Other fish that usually fight on sight lie down together, as it were, in this shining presence, as might a lion and a lamb.

The operation of sounding or of fishing at a depth of tens of thousands of feet requires much skill in both the management of the ship and of the sounding apparatus. In ordinary deep-sea sounding a three-eighths-inch steel wire is used. The tension on this wire must be constant, else it will kink, thus reducing the tensile strength fifty per cent. Ocean currents complicate deep-sea exploration. A surface current is quickly detected and guarded against, but when the rope or sounding line is swept under the bottom of the ship by a submarine current, with, perhaps thousands of fathoms of line out, it requires great skill and patience to clear the line without kinking, and thereby possibly losing a portion of it. When a deep-sea sounding is to be taken the sinker is lowered to the water's edge. A thermometer and water specimen cup are clamped on to the line of wire. An officer takes his station beside the sounding machine. Seamen are at hand attending to the guide pulleys. A fireman stands with his hand on the throttle of the sounding engine, awaiting the officer's command. The record keeper takes his position beside the register where he can read it readily. This register shows the number of fathoms of line put out. At the order "Let go!" the sinker shoots down into the ocean at a speed of ten or fifteen feet per second. The record keeper makes a note of every 100 fathoms of line paid out. The officer of the deck maneuvers the ship in a way that will keep the wire line vertical. The instant the sinker strikes the bottom of the sea, miles below the ship, the sounding engine is stopped. The record keeper notes the number of turns indicated on the register, and the slack line is hove in by hand until it clears the bottom. Then the sounding engine is reversed and the line is hauled aboard about as fast as it was paid out.—*San Francisco Examiner.*

SPEED OF TROLLEY CARS.

The Brooklyn trolley companies seem to be between the devil and the deep sea. On the one hand, people are crying out because of the number of accidents, and they demand that the speed of cars shall be so regulated that accidents will be reduced to a minimum. On the other hand, are those who favor rapid transit, and who claim that accidents are largely the result of carelessness on the part of the victims themselves. The following letter clipped from the Brooklyn Eagle voices the sentiments of this latter class.

To the Editor of the Brooklyn Eagle:

I can bear willing testimony as to long waits for trolley cars and snail like rate of speed, but I must say, however, that I am not entirely in sympathy with Mr. Schieren and his so-called trolley reform legislation. To my mind, no better safeguard can be thrown around the public than that which they can put into practical effect themselves. Let every man, woman and child make good use of the two eyes and such brains as it has pleased God to bestow upon him or her, and I venture to suggest that the newspapers will have fewer trolley accidents to chronicle. It doesn't require much of an effort to look up and down the street to see if it can be safely crossed. Impress on the minds of children the great necessity for so doing and it will soon become a habit. It's this heedless rushing to and fro that is responsible for most of the accidents. How often do we see children dart in front of an opproaching car, barely escaping in safety. Had an accident resulted of course the motorman is blamed. Right is right, all the way through, and I think it will be conceded that the majority of accidents is attributable to the carelessness of the injured themselves. The companies should be restricted to a certain extent but let us have reasonable speed and plenty of cars. There's no necessity for one hundred thousand people signing a petition for slower speed. The other nine hundred thousand want to go a little quicker. Let the Eagle start in on a campaign of trolley education; how to avoid accidents, etc. The results will be more satisfactory, and 'twill not be long before "Neath the wheels of the juggernaut" will be a dream of the past.

JAMES H. GLOVER.

491 Seventh avenue.

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BELL TELEPHONE DECISION.

Reasons Advanced by the United States Court of Appeals for Differing with Judge Carpenter—Verbal Decision Confirmed.

FRAUD WAS NOT RESORTED TO AS CHARGED.

On May 18th the United States Circuit Court of Appeals in announcing its verbal decision in the suit brought by the United States against the Bell Telephone Company relative to the Berliner patent, promised a written opinion about June 10. It was only handed down yesterday afternoon (June 14th) at 4 o'clock, and covers forty pages of type-written matter. A synopsis embodying the most important points is appended.

The court says: "The pith of the case as stated briefly for the counsel for the United States, is:—

"1—That patent 463,569 is void for illegal delay in its issue and

"2—That it is also void on the ground that the prior patent 233,969 was granted upon the same application, to the same applicant for the same invention."

The court then quotes from the bill the substance of allegations in the bill relative to Berliner's application and its scope and as to the company's wrongful delay in prosecuting the application and its attempt to delay the same. So far as the law is concerned, the patent in suit is to be tested independently of the Bell patent. The court quotes extensively from the defendants' answer to the bill, and refers to the charges that the Telephone Co. had bribed the commissioners of patents to hold the Berliner patent, etc., but says that the charges against the commissioner or any other officer of the patent office of conscious violation or neglect of duty or ignorance or incapacity are unsupported by the proofs in the case, unless it can be claimed that they constitute the language which the law implies in consequence of delays which possibly might have been prevented by the public officials.

The portions of the answer of the defendant which are quoted by the court are in substance that the patent was granted to the grantee by the proper officers of the government after a thorough examination. No attempt was made to delay the issue of the patent and if there was undue delay it was caused by the acts of the complainant and not the respondent.

So far as the proofs go, the course of the application was in accordance with the usages of that office, and was such as the officials there acting in good faith and according to their practical experience determined at the time to be on the whole the best. What would have been the practical result of the theoretical courses suggested, with an application around which centered so much powerful hostility as gathered about this one, it is impossible to ascertain by any method or determination given by the courts.

The duty of the Bell Co. was to get its patent with the least possible delay by the exercise of all its legal rights. In its own interest the American Bell Telephone Co. had a right to go to congress for legislation touching the general course of proceedings in the patent office. The imagination can hardly put a limit to the things it had a right to do. To say, therefore, that it was bound to do in the public interest all that it had a right to do in its own, is a proposition so unreasonable that the mere statement of it by the U. S. seems to confess the weakness of its case.

The court quotes from the bill a statement that the patent might have been put through had the Bell Co. made a fair, candid and strong presentation of the facts.

"But the proposition is that there was on the part of these officials a gross dereliction of duty. We are compelled to say that if this record suggests any derelictions of official duty, it was in the form of a continued hostility to the American Bel Telephone Co., and of an indisposition to grant the application for the Berliner microphone, with a concurrent disposition to nurse and favor the Drawbaugh application.

"Notwithstanding, as we have already said, the proofs do not convict the officials. They show enough to have warranted the American Bell Telephone Co. in guarding itself against the possibility of such a disposition on their part during the period covered by the nine years between June 9, 1882, and the issuing of the patent now in dispute. The court considers several cases relied on by the U. S. and says that they do not apply in this case.

Referring to the statement that the commissioner was not personally advised of the true relation of the application and that the American Bell Tel. Co. was in fault for not bringing them to his attention, the court says that the record shows beyond question that the Berliner and Edison application, which went hand in hand, had become so notorious that the knowledge of them permeated the patent office from the head to the foot.

"The practical summing up of these various suggestions (of the United States) is that the American Bell Telephone Co. is in effect censured for not reforming both the practice and the officials of the patent office. We think this demand is without parallel or precedent, and of a nature to require the legal mind to reject it on the mere statement.

"The most that can be claimed by the U. S. is that the officials of the patent office, having all the law and facts before them, erred in the free exercise of their free judgment in the determination that the earlier patent did cover the invention described and claimed in the later one. Even were this so, the result was not a mistake in the sense of the law in its application to the principles of cancellation of deeds and other instruments, but it was merely an erroneous judgment and determination of the ultimate fact deducted from the primary fact, all of which were known.

"We have shown that the action of the commissioner as far as this issue we are now considering is concerned, was merely a finding of the ultimate facts from other facts, all of which were known to the officials; and the principle which we thus use in the interpretation of the statute (sec. 4893), is one of very general application.

"It is clear on this part of the case, that we are barred from taking jurisdiction by reason of the statute provision which gives special remedies to an applicant whose patent is refused, and passing by this, that also the issue of this patent was within the scope of the authority of the commissioner, and that no mistake being proven, and no other equitable ground appearing, we cannot revise his action in this suit.

"The U. S. has filed a motion praying that if we find for the appellants, we will reserve leave to the circuit court to permit an amendment at bar alleging that the American Bell Telephone Co. did directly agree with the representatives of the Drawbaugh application, that the determination by the patent office of the question of priority, should abide the decision in the telephone cases, that these parties acting in concert, did procure the commissioner of patents to consent to such postponement and thus that the American Bell Telephone Co., by its own act, did procure the postponement of decision of priority, without necessity or right, in violation of its duty to speed the patent for the microphone. The decree of the circuit court is reversed, and the case remanded to that court with directions to dismiss the bill."

The Cascade Lumber Company of Burlington, Iowa, is about to inagurate a unique method of increasing its capacity. Its big plant at the cascade is being equipped throughout mill and yards with electric lights, and the mill will be operated day and night. By this method it is expected to nearly double the capacity of the mill and the number of hands employed without building any additions to the plant or buying any more new machinery at present.

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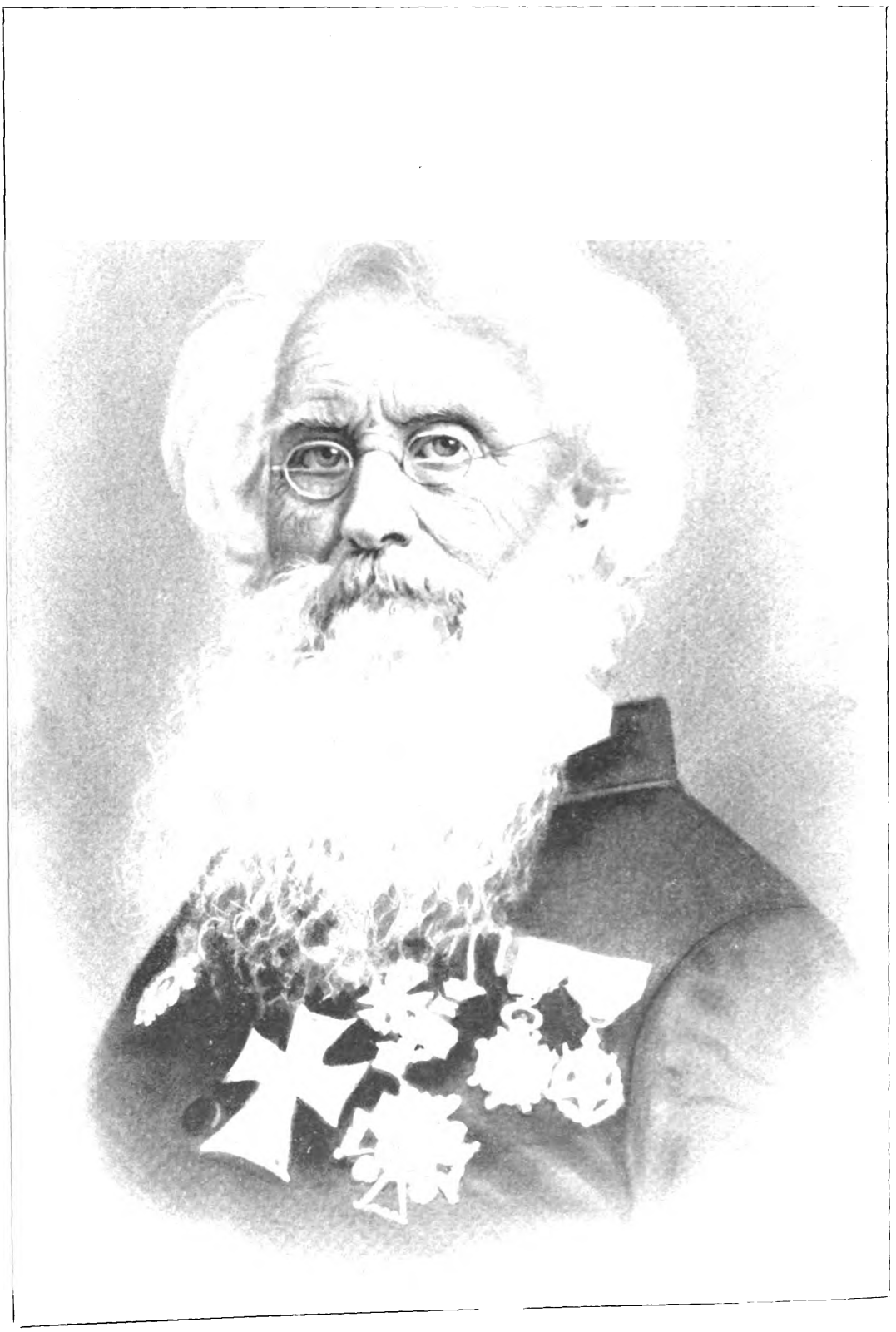

SAMUEL FINLEY BREESE MORSE.

Born at Charleston, Mass., April 27, 1791. Died April 2, 1872. Mr. Morse in his earlier manhood was a portrait artist. His famous achievement was the invention of the Electro-magnetic Recording Telegraph. He also first demonstrated the practicability of the sub-marine telegraph cable.

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The Electrical Journal.

Vol. 1. CHICAGO, JUYL 1, 1895. No. 3

THE NERVES OF A GREAT CITY.

Fire and Police Departments Operated by Telephone and Telegraph —Protection to Water Works—River Traffic Controlled.

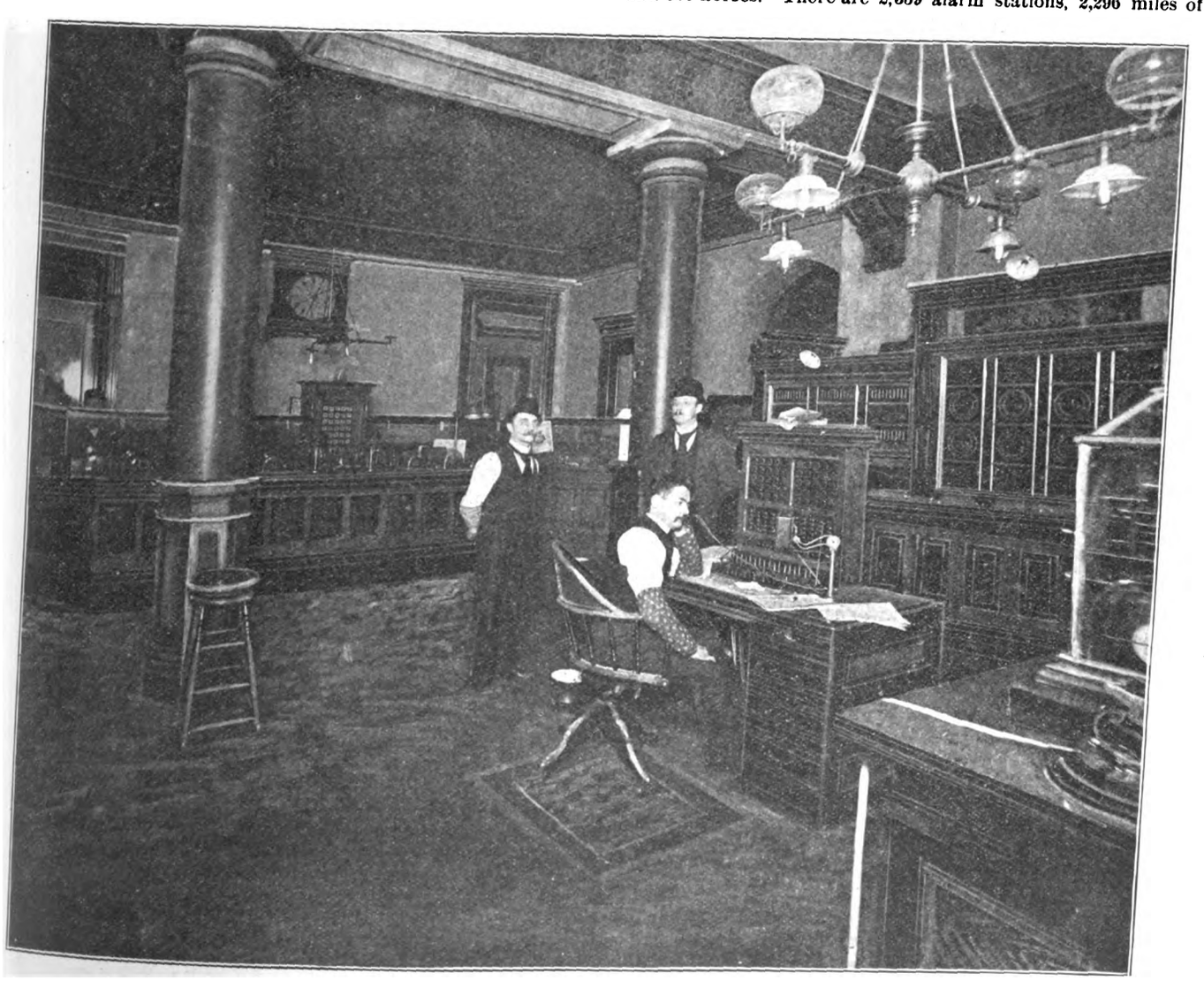
ELECTRICITY IN THE PUBLIC SERVICE.

In my last paper I discussed the question of electrical installation as it appertained to the safety of people and property from fire.

I must be allowed to confine myself to what has been, and is being done in Chicago, excepting where the nature of things will allow of comparison.

That Chicago has taken the lead in those directions that look to fire protection is hardly to be wondered at when her past severe lessons are considered.

The fire fighting force of the City at the present time consists of 1,063 men, 88 steam fire engines, 3 hand engines, 26 chemical engines, 4 fire boats, 53 chemical extinguishers, 42 hose wagons, 25 hose carriages, 31 hook and ladder trucks, 68 portable pumps, 1 telescope water tower, 142,243 feet of hose, and 458 horses. There are 2,359 alarm stations, 2,296 miles of overhead wire and 3,359,500 feet of underground wire, covering an area of 178 square miles. The greatest distance between two engine houses is 29 miles. There were, during the fiscal year 1894, 5,174 fires, or nearly one fire for every hour, day and



CENTRAL FIRE ALARM STATION, CHICAGO.

There are other branches of the public service of equal importance with and closely allied to that mentioned, and I shall, in this paper, review as briefly as maybe, some features of equipment that largely partake of police and patrol character.

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night, involving a total loss of property of the value of $3,254,140.

I have found it necessary to give these figures in order to show the magnitude of the task of handling such a department.

THE "JOKER" SYSTEM.

By old methods, when a fire was announced to the central station, it was communicated to all other stations by the gong system. This delayed the department during the slow ringing of the gong, which gave the location by numbers. The "Joker" system, designed by an officer of, and for the city of Chicago, made it possible to give instantaneously, the location of a fire, from the call box to the central station and to all other fire stations simultaneously, and with unerring accuracy, over a tape marker. This invention makes it unnecessary for the department to wait for the gong, and many seconds and even minutes of valuable time are saved.

THE "STILL SWITCH."

The "Joker" system gave great expedition to the service, but it made no provision by which men and horses might be saved the severe exertion of getting ready for every fire, day and night, no matter in what part of the city it occurred. For this relief, a second invention was made, also by an officer of, and for the city of Chicago, called the "Still Switch." This is an attachment, placed in station houses, composed of three parts, operated by three buttons. Its operation makes it necessary for one man to be constantly on watch, day and night. When an alarm sounds on the ticker, the watcher presses a button if it is desired that no noise be made. Immediately the tape runs off and gives the location of the fire. If the fire is in that company's district, the watcher presses a second button which calls the men and horses. It is possible that the watcher may not be at hand, or he may be asleep. If he fails to keep his finger on the button, the gong will ring and the company will be aroused, so that the "Still Switch" is a check on the watcher and is an unerring guide as well as a great boon to the men and horses.

Another part of the service is called the "Universal Switch," and its office is to communicate instantaneously with every engine station in the city simultaneously, either by telegraph or telephone. This service is used in the event that some one station is notified verbally of a small blaze too insignificant to call up the department, yet important enough to call out a company.

An alarm of fire is usually given by a citizen or police officer pulling down a hook in one of the fire alarm signal boxes located on the street corner. This action winds up a spring which in turn operates the mechanism so as to send an arbitrary signal calling to the fire a certain number of fire companies, and one or two battalion chiefs. If the fire be too large for the companies responding to the first alarm to handle, one of the battalion chiefs sends in signals from the box, called "second alarm," "third alarm," "special call," etc., and calling to the scene the number of companies required to master the fire. A second or third alarm of fire always calls out the chief fire marshal and is usually followed by a moving up of companies to take the place of those out on duty, in order that all districts of the city may be covered at all times. This "move up" movement of the department is also directed from the central office, from an outline map of the city on which are placed pins indicating at all times the whereabouts of all companies of the department, the map being in reality a species of chess board.

These are some of the directions in which electricity serves the city of Chicago through its fire department. By means of this mechanism, the department can be controlled as if by clockwork. The importance of this may be readily understood, when it is stated that there have been as many as fifty-five engines at work on one fire, thus necessitating a "move-up" in the whole force.

THE POLICE ELECTRIC SERVICE.

The central station has a firm and complete control of its men by means of the telegraph and telephone. There are in the city at the present time and in operation, 887 public police boxes and 370 private ones, the latter being placed in private property at the expense of the owners, and maintained at the expense of of the city. These private boxes have three calls—one for fire, one for the police, and one for testing purposes.

The police use the signal boxes for calling for help and for the health department, and police patrol, in case of an accident and when arrests are made: but in addition to this service, every man on "beat" is required to call up his station every thirty minutes. This is not only a check to keep the men awake and at duty during the night, but it enables the headquarters to communicate orders to every man on duty every half hour. As an instance of the importance of this latter feature I will cite an occurrence:—A negro killed an officer on the west side of the city and got away. By the use of the police telephone calls and the patrol wagons, 500 men were on the scene of the murder within forty-five minutes, and a complete cordon was thrown round the neighborhood. The murderer was caught within the surrounded area, and, as it happened, by a detachment of men whose station was nine miles distant.

RIVER DISPATCH SERVICE.

Another branch of the public service is the Chicago river dispatch system, by which the traffic on the river is manipulated so that there are no collisions, and so that bridges that would, without this service, be opened every few minutes, are now opened much less frequently. It consists of a telephone and telegraph service with stations at intervals along the river. Boats coming in are held at the mouth of the river until there are four or five, then they are sent in close together so that one opening does for them all. The system is so operated that boats going in opposite directions do not meet in narrow ports of the waterway.

ELECTRICITY FOR THE WATER SERVICE.

All the cribs, from which the water supply of the city is obtained, are connected by telephone with each other, and with the department headquarters in the City Hall. During stormy weather, and in the winter time, this service is indispensable. By its means, men at the cribs can call for assistance in case of danger, or communicate in the event that storms cut off their other communications with the shore. It has often been the means of restoring disturbed structure before damage could be done, and it has enabled the department more than once to get its men out of dangerous places.

There are many other directions in which electricity adds to the efficiency of the public service, but those I have mentioned seem to me the most important.

John P Barrett

New York Notes.

The proposition of the New York Aldermen to extend the railway franchises of existing companies, notwithstanding the fact that other companies were willing to pay (the city) for the privileges, seems to have brought up another one of those storms that have had such salutory effect in cleaning the moral, social and political atmosphere of the city recently. Mayor Strong has already vetoed the proposition and has incidentally declared for the sale at auction of all public franchises by the city (not by the aldermen). This plan is more utopian in its scope than most successful reform moves, and it remains to be seen whether it will succeed. Citizens generally agree with Mayor Strong, doubting only the practicability of the plan. It has been advanced in theory, for so long by reformers however, that the result will be watched with much interest.

A question not to be lightly dismissed: The question of lighting carriages after dark.—*N. Y. World.*

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CENTRAL STATION ECONOMY.

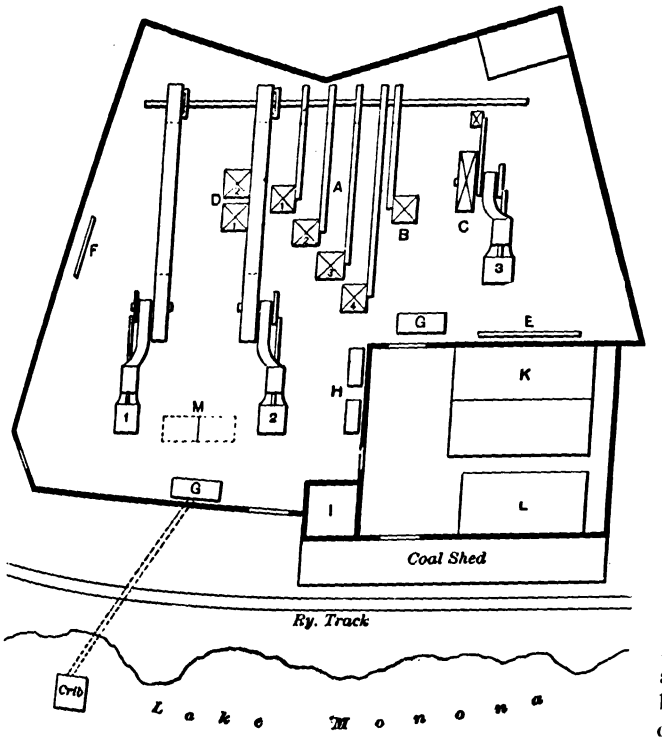
Paper by Dugald C. Jackson and Arthur W. Richter—Read Before the American Society of Mechanical Engineers at Detroit.

COMBINED RAILWAY AND POWER PLANT.

The central station of the Four Lakes Light and Power Company supplies the power for the electric lighting of Madison, Wis., and also supplies power for the Madison City Railway. The station is situated on the bank of Lake Monona, in a fairly central location (Fig. 1).

The boiler-room contains two return tubular boilers, rated at 110 horse-power each, and one Stirling boiler of 200 horse-power capacity. The engine room is equipped with three Russell compound engines, two Davidson jet condensers, and two Davidson feed-pumps.

Engine No. 1, 380 horse-power capacity, is belted to the main shaft, from which are run four Thomson-Houston arc light machines, each of which has a capacity of fifty 1,200 candle-power lamps, and one Westinghouse alternator of 750 lights capacity. Two other alternators, a Slattery and a Thomson-Houston, are also installed but are to be removed.



A, arc light dynamos; *B*, Westinghouse alternator; *C*, monocyclic alternator; *D*, railway generators; *E*, electric light switch board; *F*, electric railway switch-board; *G G*, condensers and pumps; *H*, feed pumps; *I*, oil room; *K*, return tubular boilers; *L*, Stirling boiler; *M*, hot wells; *1, 2, 3*, Russell engines.

FIG. 1.

Engine No. 2, 190 horse-power capacity, is used for running the railway generators. These are two 90 K.W. General Electric machines of 500 volts, 180 amperes, speed 650, and are belted tandem fashion from the fly-wheel of the engine. A third tandem belt from the same fly-wheel runs over a clutch pulley on the main shaft, and the shaft can therefore be driven from this engine when desired. The two generators are connected to the same bus-bars, and supply power for the operation of the Madison Street Railway, and for a number of stationary motors which are connected to a special power circuit run out from the bus-bars. Both of the above engines are connected to one of the Davidson condensers.

Engine No. 3, 400 horse-power capacity, is directly connected to a 300 K. W. "Monocyclic" alternator, and condenses into another Davidson condenser and air-pump. The alternating current output of the station is used exclusively for incandescent lighting.

ENGINE DIMENSIONS.

NOS. 1 AND 3.

Stroke, 24 inches.
Diameter of high-pressure cylinder, 15 inches.
Diameter of low-pressure cylinder, 24 inches.
Diameter of high-pressure piston-rod, crank end, 3 inches.
Diameter of high-pressure piston-rod, head end, 2⅝ inches.
Speed, engine No. 1, 134 revolutions per minute.
Speed, engine No. 3, 152 revolutions per minute.

NO. 2 RAILWAY ENGINE.

Stroke, 20 inches.
Diameter of high-pressure cylinder, 13 inches.
Diameter of low-pressure cylinder, 20 inches.
Diameter of high-pressure piston-rod, crank end, 2¾ inches.
Diameter of high-pressure piston-rod, head end, 2½ inches.
Speed, 133 revolutions per minute.

The station is operated by one engineer and one fireman from midnight until noon, and by one fireman, one head engineer, and one assistant, from noon until midnight, and one oiler from 6 p.m. until 12 p.m., making a total of six station employees for the 24 hours' run. Each 24 hours during the week, current is furnished to the electric railway and power circuits for 17.5 hours, and to the alternating current circuits for 23.5 hours, except on Sunday, when the alternators are shut down for an additional 12 hours. Current for arc lighting is supplied principally between the hours of dusk and midnight, though certain arc-light circuits are operated all night.

This station is one of that type, so well known to electrical engineers, which has grown to considerable proportions from a small and poorly conceived beginning, and which therefore may be said to suffer through its own growth. During the past two or three years it has been quite thoroughly overhauled, and its physical condition has been greatly improved, but only at the expense of a considerable addition to the capital account. The results of the test which are given may be taken to represent results fully equal to those obtained by the average electric station in our cities of the smaller size. (Madison has 15,000 inhabitants). This statement will doubtless be viewed with surprise by the numerous members of this Society who are experts in steam engineering, and who carry continually before their eyes the remarkable economy obtained in pumping plants, but that the statement is fully borne out by the facts will be affirmed by every electrical engineer of experience.

The object of the test recorded in this paper was to determine the efficiencies of the boilers, engines and generators under actual operating conditions, nothing having been done either before or during the test to change the conditions from those occurring in the regular daily run. All the data required was obtained and recorded entirely independently of the regular employees, who were required to attend to the operation of the station, exactly as is done day after day and week after week. A trial test of four hours' duration was made beforehand, in order to familiarize the observers with their work and to ascertain whether all the arrangements were well conceived. All reasonable precautions were used to make the data obtained reliable, and all instruments were supplied from the laboratories of the University of Wisconsin, and were compared with the laboratory standards. All electrical instruments used were calibrated by means of a Kelvin standard balance. The steam-pressure guages and indicator springs were standarized by comparison, while hot, with a mercury column. The scales, thermometors, etc., were tested for accuracy by comparison with proper standards.

The test began at 6 a.m. Monday, when the engines started up for the day, lasting until 5:30 a.m. Tuesday, when the engines

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stopped for their half-hour breathing spell, and may be considered successful, as nothing more serious than the occasional breaking of an indicator cord occurred to interfere with the results. Four of the observers, one having general supervision of the test, another overseeing the weighing of the coal, another the weighing of the water, and a fourth having charge of the calorimeter tests, were on duty through the entire run. These four men, Messrs. Burgess, Frankenfield, Mead and Crane, were members of the senior class in electrical engineering in the University of Wisconsin, and handled their work excellently. They were assisted by a certain number of experienced student observers, about twenty in all, who were required to read the various ampere meters and volt meters, take indicator cards, etc. The test was generally supervised by two of the assistant professors of the university. During the whole of the test the station presented no confusion, but was operated with the usual systematic regularity.

TESTS.

The coal was weighed as it was brought into the boiler-room. The water-level and steam gauges were kept as nearly constant as practicable, and at the close of the test the water in the Stirling boiler was at the original level, while in one of the return tubular boilers it was 1.5 inch above the string, and in the other a little over an inch below it, so they were considered as practically at the same level. The Stirling boiler was in use during the entire run, and at 4:45 p.m. and at 5:45 p.m. the two tubular boilers were successively cut in and were shut off again and the fires banked at 12:35 a.m. The coal used in getting these boilers up to pressure (nearly 500 pounds) was not counted as part of the coal consumption in the computed results.

Calorimeter tests of the steam were made every hour at the boilers, and as frequently as possible at the engines, while in service. Throttling calorimeters were used, except at the railway engine, during the day-time, where there was so much water present that the throttling calorimeter could not be used, and a separating calorimeter was resorted to. The poor quality of the steam at the engines was due to the arrangement and condition of the steam mains. Engine No. 2 received the drain of the greater portion of the system. The steam-pipe was connected to the under side of the main and was uncovered at the time of the test. The pipe leading to engine No. 3 was also uncovered, and as the pipe is of considerable length the condensation is considerable, while the valve provided to cut the steam from that pipe during the period when the engine is idle was not made use of. The pipe leading to engine No. 1 was covered, but no provision was made to cut the steam from that pipe when the engine was not running.

The water was measured by means of two tanks placed on scales. Both feed-pumps were put into use, one as an auxiliary, to pump the water from the hot well into the tanks, and the other to feed the boilers. The latter pump communicated with the tanks by two branches of piping connected by a three-way cock, and a hose was attached to the other pump, so that one of the tanks was filled while the other was being emptied. The exhaust pipe of the regular feed-pump was connected to the vacuum of the condenser, and the steam consumption was figured from cards taken at frequent intervals, the number of strokes being recorded on a continuous recorder. The steam

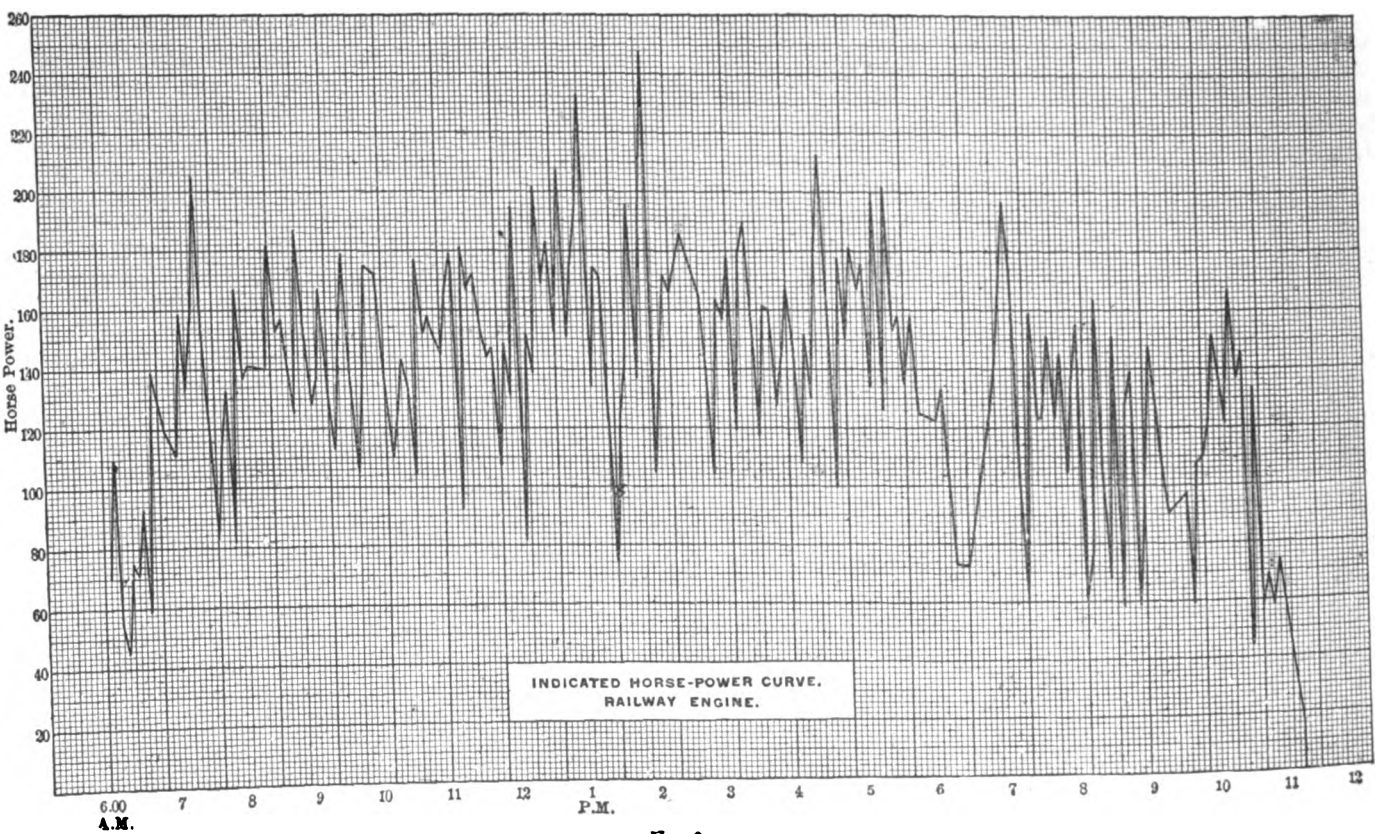

FIG. 2

consumption of the auxiliary pump was ascertained by running the exhaust into a small surface condenser, furnished from the university laboratory, by which means the condensed water was collected and allowance made therefor.

The railway engine, No. 2, was started at 6 a.m. and continued running until 11:10 p.m. During the day, from 6 a.m. until 6:30 p.m., this engine, besides driving the two railway generators, drove the main shaft, to which a Westinghouse alternator was belted, supplying the day demand on the incandescent circuit. This engine was indicated every five minutes, indicators made by Dreyer, Rosenkranz and Droop, of Hanover, Germany, being used on the low-pressure cylinder, and Tabor indicators on the high-pressure cylinder. These indicators were supplied with electro-magnetic devices for taking the four cards simultaneously on closing a switch, the current being supplied from storage cells. Friction cards were taken upon starting up with the generator fields excited and again with the field circuit broken. The speed was obtained by means of a continuous revolution counter. Two ampere meters, through

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which the current supplying the railway feeders passed, one ampere meter on the power circuit, and a volt meter giving the dynamo pressures, were read every half minute. The condenser pumps were indicated at half-hour intervals and the speeds were taken.

At 6:10 p.m. the arc-light engine, No. 1, was started and continued running until 5:30 a.m. At the same time the direct connected engine, No. 3, was set running, and the supply for the incandescent circuit was changed from the Westinghouse machine to the "Monocyclic" alternator. The railway engine, No. 2, now no longer drove the main shaft, but the belt ran over a loose pulley on the shaft. The arc-light engine, No. 1 was indicated every fifteen minutes, and the direct-connected No. 3, every ten minutes, and the speed obtained from continuous revolution counters. Friction cards were taken both before and after the run. The current of the arc machines was measured by a Weston ampere meter, and the voltage was obtained by a Weston volt meter in series with a high resistance, the apparatus being placed as far from the machines as possible to avoid any disturbance which might be caused by stray magnetism. Ampere meter and volt meter readings for the Westinghouse alternator were taken every fifteen minutes, and the "Monocyclic" output was taken by five-minute readings. The power factor of the load on each of the machines was ascertained by means of a station watt meter, loaned by the General Electric Company.

There can be no question in regard to the reliability of the results averaged from readings taken as often as was done in this test, except in the case of the railway machinery. It is still an open question as to the best method of determining the average power developed by an electric railway engine; but the results of considerable experience with electric railways on the part of one of the authors makes us feel certain that results are obtainable by the arrangements which were used in this test, which are as accurate as those obtainable by any method yet set forth.

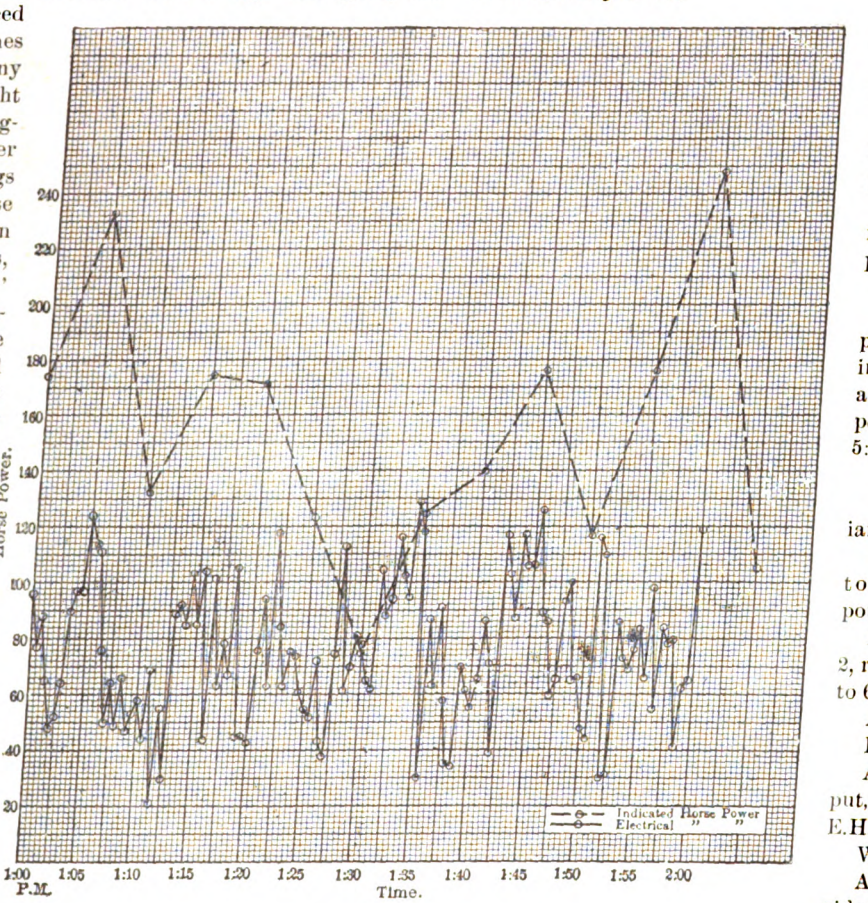

FIG. 2A.

RESULTS OF TEST.

Boiler efficiency.

Quality of steam.

Stirling, 6 a.m. to 6 p.m., 99.2 per cent.
6 p.m. to 5:30 a.m., 99.7 per cent.

Return tubular boiler No. 1, 4:45 p.m. to 12:30 a.m., 97.3 per cent.

Return tubular boiler No. 2, 5:45 p.m. to 12:30 a.m., 98.5 per cent.

Total average, 98.8 per cent.

Average pressures:

Steam, 89.5.

Barometer, 29 inches.

Draught (inches of water), .3.

Average temperatures:

External air, 46.2 degrees Fahr.

Boiler-room, 58.9 degrees Fahr.

Escaping gases, 422 degrees Fahr.

Temperature of hot well, 82.24 degrees Fahr.

Temperature of feed-water, 123.5 degrees Fahr.

Factor of evaporation, 1.119.

Water pumped into boilers, 102,349 pounds.

Equivalent evaporation from and at 212 degrees, 114,508 pounds.

Total amount of coal burned, 17,103 pounds.

Total ash, 1,871 pounds.

Total combustible, 15,232 pounds.

Per cent. ash, 10.9 per cent.

Water evaporated per pound of coal, 5.98 pounds.

Water evaporated per pound of combustible, 6.72 pounds.

Equivalent evaporation from and at 212 degrees, per pound of coal, 6.69 pounds.

Equivalent evaporation from and at 212 degrees, per pound of combustible, 7.52 pounds.

Steam used in throttling calorimeters, 385.7 pounds.

Steam used in separating calorimeter, 35.07 pounds.

Total, 420.8 pounds.

Steam used by feed-pumps, as figured from indicator cards, from 6 a. m. to 6 p. m., 538.5 pounds. From 6 p.m. to 5:30 a.m., 472.3 pounds.

Total, 1,010.8 pounds.

Steam used by auxiliary pump, 449 pounds.

Steam to be charged to engines, 100,469 pounds.

Engine efficiency. No. 2, railway engine. 6 a.m. to 6 p.m.

Average I.H.P. 117.5.

H. P., hours, 1,410.

Average watts output, 69,200, equals 92.8 E.H.P.

Watt hours, 830,387.

Average E. H. P. divided by average I.H.P. equals 78.9 per cent.

Coal consumed in 12 hours, 7,550 pounds.

Per cent. ash, 9.9 per cent., equals 750 pounds.

Combustible, 6,800 pounds.

Water pumped into boilers, 43,172 pounds.

Steam consumed by pumps and calorimeters, 891 pounds.

Water charged to engine, 42,281 pounds.

Water per I.H.P. per hour, 30.0 pounds.

Coal per I.H P. per hour, 5.35 pounds.

Combustible per I.H.P. per hour, 4.82 pounds.

Quality of steam, 95.7 per cent.

Moisture in steam, 4.3 per cent.

Dry steam used by engine, 40,460 pounds.

Dry Steam per I.H.P. per hour, 28.7 pounds.

Watt hours, per pound of coal, 109.9.

Watt hours, per pound of combustible, 122.1.

Station efficiency.

6 a m to 5:30 a.m., 23.5 hours.

Average I.H.P., for 23.5 hours, 160.5.

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Maximum E.H.P., 350.4.

Average E.H.P., 117.9.

Average watts for 23.5 hours, 87,946, which is 2,066,729 watt hours.

Average E.H.P. divided by average I.H.P., 73.4 per cent.

Load factor for 24 hours, 32.4 per cent.

Coal consumed, 17,103 pounds.

Combustible, 15,232 pounds.

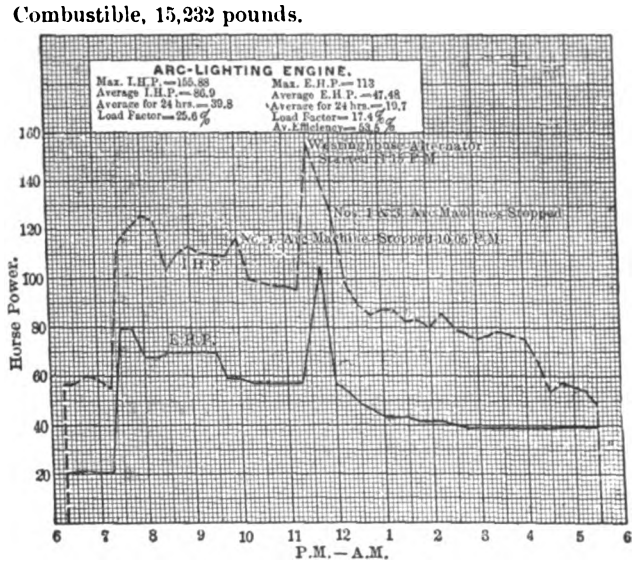

FIG. 3.

Water pumped into boilers, 102,349 pounds.

Steam evaporated and charged to engines after subtracting that used by calorimeters and feed-pumps, 100,470 pounds.

Water pumped into boilers per engine I.H.P. hour, 27.1 pounds.

Coal per engine I.H.P. hour, 4.5 pounds.

Combustible per engine I.H.P. hour, 4.0 pounds.

Watt hours per pound of coal, 121.

Watt hours per pound of water, 20 8.

Average quality of steam, railway engine, 96.2 per cent.

Average quality of steam, arc-light engine, 97.1 per cent.

Average quality of steam, Monocyclic engine, 97.8 per cent.

Average, 96.8 per cent.

Dry steam used by engines, 97,214 pounds.

Dry steam per engine, I.H.P. hour, 25.8 pounds.

Average I.H.P. of condenser pump No. 1, 2.62.

Average I.H.P. of condenser pump No. 2, 1.96.

Horse-power hours of condenser pump No. 1, 61.6.

Horse-power hours, pump No. 2, 9.8.

Friction load of engine No. 1, 22.4 with shaft.

Friction load of engine No. 2, 12.2 without shaft.

Friction load of engine No. 3, 22.5.

Total friction load, 57.1 I.H.P.= 11.8 per cent. of maximum I.H.P.

CONCLUSIONS.

The principal results of the tests are shown graphically in the accompanying figures. Fig. 1 shows the general arrangement of the plant; Fig. 2 the indicated horse-power of the railway engine during the day; Fig. 2a, the indicated and electrical horse-powers of the railway plant during one hour; Fig. 3 shows the indicated horse-power of the arc-light engine and the electrical output of the dynamos driven from it; Fig. 4 shows the same thing for the direct-connected engine. In Fig. 5 the full line shows the total indicated horse-power developed in the station during the test, while the differently shaded areas show the part played by each of the three engines.

During the past three years several papers have been read before this Society dealing with the operation of electric railway stations, but no authoritative records appear, which cover the operation of the average small station, which combines in one the requisite plant for electric lighting and electric railway service. The individual action of engines, dynamos and auxiliary apparatus, under the conditions here met with, is so well known that it is thought best by the authors not to burden this paper by indicator cards of well known forms, or by long tabular records. We wish, rather, to call attention to certain points which bear with somewhat startling force upon the expense of operating these combined stations. It has usually been considered that combination stations may be operated at much less total expense than is required for the operation of two small stations when the lighting and railway plants are separate. This question may be considered under four heads. First, station labor; second, fuel economy; third, superintendence; fourth, fixed charges.

1. In regard to station labor, the plant under consideration (which we will call the Four Lakes Plant) probably could not be improved, and if the lighting and railway divisions were separated, not less than seven men would be required where five men are now employed, and the labor account would be proportionately larger for two stations than for one.

2. The fuel economy of the Four Lakes Plant is fully equal to that of the average medium-sized plant, but it is probably no better than would be given by similar engines and other machinery in separate plants. The coal used during the test was a mixture of Indiana block, costing $3.35 per ton, and Illinois coal, costing $2.72 per ton. The evaporation shown by the boilers was, on the whole, excellent, considering the kind of coal used and the fact that the boilers *were in regular service condition*. The fuel economy of the Four Lakes Plant could be improved by several minor changes; this is especially true in regard to the arrangement of the dynamos, which now require the countershaft to be unnecessarily run all day, and in regard to the piping, which might be readily changed to deliver better steam. (Some of these changes have already been made since the test). But these changes would not give the combined plant any advantage over the separate plants. Better fuel economy would also be obtained by closer attention to the details of operation than is given in this plant, but the watt hours developed per pound of coal and per pound of water compare favorably with the reports of the National Electric Light Association for similar stations.

3. The question of superintendence requires consideration from two sides; first where the railway and light companies are independent, and the latter sells power to the former; and, second, where one company controls both industries. In the first case, no saving is made in office force or superintendence by combining the stations; but, in the second case, a saving is doubtless effected by the combined plant.

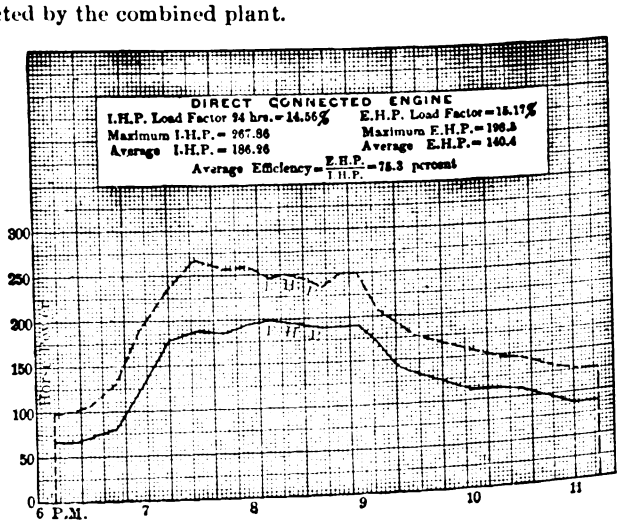

FIG. 4.

4. The preceding divisions give little clue to the best solution for the electric plants of the smaller cities, and we must find the solution in this division. The fixed charges which may be rightfully considered as belonging to the station account depend upon the cost of real estate, buildings, and the machinery

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in place. The first two items are undoubtedly increased to some degree in the separate plants, but not so largely as might be imagined, since the running machinery for the two classes of service must be entirely independent. It is practically impossible for any engine to drive the extremely variable load of an electric railway and regulate with sufficient accuracy to give satisfaction when driving dynamos for electric lighting; and, since the underwriters have taken the matter in their hands, it is not permissible in most places to operate stationary motors from railway circuits on account of the fire risks involved in introducing ground circuits into buildings. On account of this separation of the two classes of machinery the real estate and buildings required for combined railway and lighting plants must be larger than would be necessary for either a simple lighting plant or a simple railway plant of a capacity equal to the combined plant.

The comparison of the load factors of separate and combined plants throws no particular light on this question. Thus, in the Four Lakes station, the 24 hours' engine load factor for the railway machinery, plus the day alternator, is 38.2 per cent. For the arc-light machinery alone it is 25.6 per cent; for the direct connected alternating machine it is 14.56 per cent. The total load factor of the station is 32.4 per cent. The term "engine load factor" is used here in its usual signification, of the ratio between

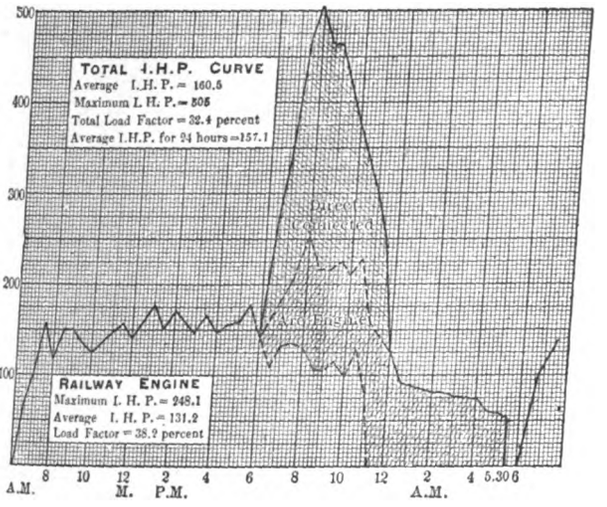
TOTAL I.H.P. CURVE
Average I.H.P. = 160.5
Maximum I.H.P. = 305
Total Load Factor = 32.4 percent
Average I.H.P. for 24 hours = 157.1
RAILWAY ENGINE
Maximum I.H.P. = 248.1
Average I.H.P. = 131.2
Load Factor = 38.2 percent
500
400
300
200
100
A.M. 8 10 12 M. 2 4 6 8 10 12 P.M. 2 4 5.30 6 A.M.

FIG. 5.

the actual indicated horse power hours' output of the station and the output which would be produced were the station run continuously at its maximum indicated load. Now, upon separating the lighting and railway outputs, we still have the railway load factor about 38.2 per cent. and the lighting load factor becomes about 23 per cent. Practically the same amount of boiler power is required in the combined stations as in the separate stations and exactly the same plant in engines and dynamos is required in the two cases. The boilers, engines and dynamos are each run at about equal average loads in the two cases, and the efficiencies are not materially different.

We therefore make the following gains by combining the electric lighting and railway plants of small cities into one station. First a fair amount in the labor account; second a small amount in the real estate and building account. The gains are not nearly so great as are sometimes asserted, nor are they comparable in magnitude to those which result from the combination of two small electric light stations in one, or two small electric railway stations in one, since in the latter cases, one economical plant of machinery may be used to do the work of two smaller and less economical plants. When a railway and a lighting station are combined, we are forced by the conditions to use separate machinery (excepting boilers) for the two classes of service.

Yeast—"Bacon refers to his girl across the East river as his Brooklyn angel." *Crimsonbeak*—"You don't mean to tell me that there's another trolley victim?"—*Yonkers Statesman.*

WILL BE HARD ON FARMERS TOO.

The competition between steam and electricity for railroad traction is seriously embarrassing the steam roads, which are nearly all burdened with overcapitalization and bonded indebtedness, and some of which have nearly exhausted their borrowing capacity. One of the most profitable branches of their business is the passenger traffic between large cities not remote from each other, and it is just at this point that the competition of the trolley roads bears hardest. The trolley usually occupies a public highway without cost; its cars can overcome heavier grades, and the general cost of construction is far below that of existing steam roads. Serious as may be the direct outcome of this rivalry to the interests of the steam roads, its indirect results are hardly of less importance. For instance, it has been estimated that electric lines have already displaced no less than 275,000 horses, and the movement has not by any means stopped yet. At a moderate computation, this number of horses would require about 125,000 bushels of corn or oats a day. A decrease of 125,000 bushels a day is equal to 45,000,000 bushels a year—enough to appreciably affect the prices of those grains. But what the cessation of this commercial demand for coarse grain fodder in the cities means to the steam railroads is an enormous loss of tonnage, not less, in fact, than 62,500 carloads. —*New York Times.*

OIL WELLS ARE GIVING OUT.

The Output In Pennsylvania From Old Sources Growing Less and No New Wells In Sight.

In spite of all that had been hoped of the drill, the month of May closed with the stocks of illuminating oil on hand not only not increased, but still further cut down. The wells completed in April and May were enough to increase the output to fabulous proportions if the number of wells alone counted. But the individual yield averaged the smallest known, with a remarkable assortment of dry holes.

From the pipe line figures for May it appears that the production of the month as turned into the lines reached 2,529,000 barrels, 35,000 barrels less than was received in April. The daily average was 81,000 barrels. The shipments for the month were 2,845,000 barrels, or a little more than in April, with the daily average of 91,784 barrels. The shipments exceeded the production in May by a daily average of 10,000 barrels. In April the shipments were but 7,000 barrels in excess, and in March less than 5,000 barrels more than the production. It is evident that the production of oil is getting farther away from the demand every day in spite of the uncommon efforts the drill has made to catch up. At the present rate of production and consumption, the 4,300,000 barrels on hand would last over a year, but the winter months will see a marked increase in the use of oil over that burned in the long days of summer. Unless a new supply is provided, the prospects are for a further whittling down of the stocks. Buckeye fuel oil is not suffering the same decrease. On the contrary it is accumulating a little.

Although all appearances point to the ultimate exhaustion of the stocks of oil, no apprehension need be felt that we wi l have to sit in the dark or return to tallow candles. Electricity is gaining a foothold everywhere, and so is manufactured gas. But even those agencies will not be tasked unduly, for the too rapid decline of stocks will call into play the fuel oils of Ohio, which can make a fairly good illuminant. Decrease of stocks with the attendant higher prices will be followed by greater economy in the use of oil, and in that way a saving will result which will help to maintain the equilibrium. Then, while it is not at all probable, it is still possible, that another Bradford may be concealed somewhere on the globe to furnish the stocks that the future shall demand.

In any event the ingenuity of the Yankee asks nothing better than a chance to serve his fellows, and if oil cannot furnish the light we need American shrewdness can.—*Pittsburg Times.*

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ELECTRICAL EQUIPMENT RULES.

Detailed Explanation of the Regulations Imposed by the City of Chicago and the Board of Fire Underwriters.

OF INTEREST TO ELECTRICAL CONSTRUCTORS.

This series of papers is not intended for the instruction of experts. Its object is to show to those who are unacquainted with the laws of electricity, the reason for and the philosophy of these rules and regulations. They will be taken seriatim, and thoroughly dissected in language which will be perfectly intelligible to the youngest student.

CENTRAL STATIONS.

FOR LIGHT OR POWER.

These Rules also apply to Dynamo Rooms in Isolated Plants, connected with or detached from buildings used for other purposes; also to all varieties of apparatus therein both high and low potential

1 GENERATORS: -

a. Must be located in a dry place.

Ordinary water is the most potent enemy of the electrician. This is, however, true only of water in which more or less impurities are found, and while perfectly pure, distilled water is a poor conductor of electricity, there is no such water to be found in nature. It is water in the earth which renders that a good conductor. Perfectly dry earth is but a very poor conductor. Dampness, therefore, is to be guarded against to prevent any escape of the electric current.

b. Must be insulated on floors or base frames, which must be kept filled, to prevent absorption of moisture, and also kept clean and dry.

Here again we must guard against water in the form of moisture, by filling the wood with something to prevent the absorption of moisture. This filling may be a varnish or its equivalent in something which is a repellant of or impervious to moisture.

c. Must never be placed in a room where any hazardous process is carried on, nor in places where they would be exposed to inflammable gases, or flyings, or combustible material.

Almost any form of dust, such as that in wood-working establishments, flouring mills, etc., when mixed intimately with atmospheric air, is highly explosive. A few years ago, after the explosion of a mill at Minneapolis, the late Professor Tobin delivered a lecture in Chicago before the Underwriters, and explained what, up to that time had been a mystery, by exploding a mixture of the best flour and air. Alcohol, benzine, all inflammable gases may also be ignited by a spark. There is positive danger, then in violating this rule.

d. Must each be provided with a waterproof covering.

This is as much for the protection of the machine as for safety. Accidental wetting may injure the dynamo as well as the insulation of the line.

2. CARE AND ATTENDANCE:—

a. A competent man must be kept on duty in the room where generators are operating,

No electrical machine should be permitted to suffer neglect from its master. The best generator known is liable to become unruly, and all electrical diseases require immediate, and often heroic treatment, to prevent damage, not only to the line or property surrounding them, but to themselves.

b. Oily waste must be kept in *approved* metal cans, and removed daily.*

Approved waste cans shall be made of metal, with legs raising can three inches from the floor, and with self closing covers.

The mysteries of spontaneous combustion are very little understood by the general public. Hundreds of cases are on record where oily, or varnished, or turpentine rags have taken fire from being allowed to lie around neglected. A building within the city limits was burned through a pail full of rags that had been used by a furniture cleaner Saturday afternoon. Monday morning when he came to finish his work he learned that the house burned Saturday night. This rule is necessary to guard against that form of fire hazard.

3. CONDUCTORS:—

From generators, switch boards, rheostats, or other instruments, and thence to outside lines, conductors—

a. Must be in plain sight and readily accessible.

b. Must be wholly on non combustible insulators, such as glass or porcelain.

c. Must be separated from contact with floors, partitions or walls, through which they may pass, by non combustible insulating tubes, such as glass or porcelain.

d. Must be kept rigidly so far apart that they cannot come in contact.

The insulation of a line—that is, the keeping it away from contact with anything which might form a by-path, or leak of current from the line—is imperative, and in order to know that such a condition exists, these wires should be in sight, and readily reached at all times. Insulation from everything of a combustible nature is also very necessary, and the two wires—the incoming and outgoing—are to be kept apart, for a contact of these two might form a short route for current back to the generator with disastrous results.

e. Must be covered with non inflammable insulating material sufficient to prevent accidental contact, except that "bus bars" may be made of bare metal.

The bus bars of the switch board are permitted of naked copper for the reason that wire or cable of sufficient size is difficult to procure, and when used is awkward to handle, and does not make a neat mechanical piece of work. Properly placed and insulated they are immovable and can do no harm.

f. Must have ample carrying capacity to prevent heating. (See Capacity of Wire Tables.)

Table of capacity of wires, Brown & Sharp Guage.

B. & S. G.	Table A. Concealed Work. Amperes.	Table B. Open Work. Amperes.
0000	218	312
000	181	262
00	150	220
0	125	185
1	105	156
2	88	131
3	75	110
4	63	92
5	53	77
6	45	65
8	33	46
10	25	32
12	17	23
14	12	16
16	6	8
18	3	5

NOTE.—By "open work" is meant construction which admits of all parts of the surface of the insulating covering of the wire being surrounded by *free* air. The carrying capacity of 16 and 18 wire is given, but no wire smaller than 14 is to be used, except as allowed under Rule 27 (*d*)

A given size of round copper will carry without becoming hot, a known amount of electrical current. That amount of current will heat a thinner wire, and this heat will increase in a known ratio for lessening diameters of wire of a similar character. These tables are for copper wire. A different table would be necessary for iron, platinum, German silver, etc., as the carrying capacities of no two metals are exactly alike.

4. SWITCH BOARDS: -

Should be approved before being placed.

a. Must be so placed as to reduce to a minimum the danger of communicating fire to adjacent combustible material.

Special attention is called to the fact that switch boards should not be built down to the floor, nor up to the ceiling, but a space of at least eighteen inches, or two feet, should be left between the floor and the board, and between the ceiling and the board, in order to prevent fire from communicating from the switch board to the floor or ceiling, and also to prevent the forming of a partially concealed space very liable to be used for storage of rubbish or oily waste.

All of the current generated at the dynamo is conducted to the switch board, and from there several circuits diverge. This

*In the code of rules as published, the definitions are placed as a supplement at the end of the book. I have thought best to bring them into the text, as part of the rule. C. C. H.

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piece of apparatus then should be as nearly perfect as possible. All parts of it should be originally well constructed and it should be maintained in that condition. It is sometimes necessary to add to or to change the existing board, and when this is done sufficient room should be available to make a clean mechanical piece of work.

b. Must be accessible from all sides when the connections are on the back; or may be placed against a brick or stone wall when the wiring i entirely on the face.

It is especially necessary to maintain order and cleanliness around, not only the boards, but all other parts of the dynamo room, so as in case of accident there will be as little as possible to encourage a conflagration.

c. Must be kept free from moisture.

d. Must be made of non-combustible material, or of hard wood in skeleton form, filled to prevent absorption of moisture.

The preference is given to non-combustible material, although hard wood with proper filling, in a skeleton form, is permitted. Boards of marble, slate without veins, either plain or marbleized, or soap stone are all excellent non-conductors, and non-inflammable. The day is not far distant when no wooden switch board will be countenanced by the authorities.

e. Bus bars must be equipped in accordance with Rule 3 for placing conductors.

As bus bars—the heavy metal bars on the switch board—are only conductors, their placing is required to be more carefully done, if anything, than the rest of the line. They have no insulation covering, which the balance of the line has.

5. Resistance Boxes and Equalizers:—

a. Must be equipped with metal, or other non-combustible frames.

The word "frame" in this section relates to the entire case and surrounding of the rheostat, and not alone to the upholding supports.

For the reason that rheostats are resistance coils, and resistance always develops heat, such a combination of coils—a rheostat—requires to be so placed that no fire hazard shall accrue. In some cases rheostats become very warm—dangerously so.

b. Must be placed on the switch board, or, if not thereon, at a distance of a foot from combustible material, or separated therefrom by a non-inflammable, non-absorptive, insulating material.

The more compactly the dynamo room accessories are grouped the better; and as the switch board is especially carefully guarded from hazard, an additional reason exists for placing the rheostat on the switch board, where one system of insulation serves for both.

6. Lightning Arresters:—

a. Must be attached to each side of every overhead circuit connected with the station.

b. Must be mounted on non-combustible bases in plain sight on the switch board, or in an equally accessible place, away from combustible material.

c. Must be connected with at least two "earths" by separate wires, not smaller than No. 6 B. & S., which must not be connected to any pipe within the building, and must be run as nearly as possible in a straight line from the arresters to the earth connection.

d. Must be so constructed as not to maintain an arc after the discharge has passed.

Lightning arresters are for the purpose of protecting property and life from lightning; and to make this protection as perfect as possible, we require an attachment for either side—the outgoing and incoming wire. They are only used for lines which extend over considerable territory—central plants. Their purpose is to lead the lightning away from the central station and from the line. Lightning may pass between two clouds, from earth to clouds, or from clouds to earth. In the first instance an electric charge may be induced in a wire on the earth, and the attraction of these two charges for each other may bring a discharge up from earth to the lightning arrester, and thus assist in dissipating it through the atmosphere, via the wire, when otherwise it might come up through some building or part of the machinery of the station.

Whether the charge is upward or downward the lightning arrester assists greatly in producing an equilibrium between the positive and negative conditions in its vicinity, and thus affords protection.

There are several forms of lightning arresters which will be shown hereafter.

Two ground connections or earths are required, inasmuch as one of these may be faulty.

A charge of sufficient pressure or tension to jump across an air gap will often be followed by the maintenance of an arc while if this gap is made wider the arc will be broken. Widening the gap increases the resistance by the introduction of air space.

C. C. Haskins.

(To be Continued.)

ELECTRICAL HOUSE HEATING.

Touch the Button and Get the Heat of a Roaring Fire—Safe and Easily Regulated.

A current of electricity always heats the conductor through which it goes. The conversion into heat of the electrical energy is always complete; there is no loss as in most other transformations, and in a given conductor the heating effect increases as the square of the current, so that twice the current gives four times as much heat, three times the current nine times the heat, and so on; it therefore becomes possible to produce almost any desirable temperature, even to that of fusion of an electric conductor, while the most refractory substances are either fused or volatilized by the heat of an electric arc which has the temperature of about 6,000 degrees Fahrenheit.

A constant current will maintain a constant temperature. How much heat shall be produced and what the temperature shall be, is only a question of apparatus, and regulation is as easy as turning a switch. Electrical heating for household purposes is therefore as feasible as heating for welding iron bars or fusing alumina. Houses may be thus heated as easily and as safely as they are lighted by electricity. It has often been talked about, but the inquirers have generally been discouraged by exaggerated notions of its relative cost. The implication has always been that people always choose the cheaper article, which is not true. For instance, a Rochester lamp may give a light of thirty candles for six hours by burning a quart of coal oil, costing two cents. The same amount of light from an incandescent electric lamp will cost as much as 10 cents; nevertheless, there are thousands who choose the more costly light because its other good qualities are considered a sufficient offset for the greater cost. Ordinary furnaces for heating houses are not half so economical as individual stoves, but no one uses the latter who can contrive to pay for the former; so in matters of convenience the cost of a thing is not the first item.

The convenience of electrical heaters in a house, their cleanliness and the simplicity of their regulation, commend themselves to every one, and when these are fairly apprehended by the well-to-do class, it is certain that such electrical appliances will be demanded, and hot air and other furnaces will be abandoned, and with them will go the nuisances of handling coal and ashes, the consequent dust and gases, the smoky chimneys, the dangerous flues, the preparing of kindling, and the expert care of the furnace with its drafts and registers.

There will be increased safety from fires, and the cost of insurance will be less. When the cost and trouble of these are set over against the cost, the convenience and safety of electric heat, the difference will not be found to be so great, but it will be willingly borne by large numbers in most communities. Once this method has a fair start, it is certain to be adopted as widely as the electric light has been, and then will soon be as indispensable.—*A. E. Dolbear in Cosmopolitan.*

If the "Telephone Protective Association of America" can give to the public cheaper and better telephone service, it will supply a "long-felt want." It is to be feared, however, that there will be considerable of a hole in its capital before it succeeds.—*New York World.*

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MADE EIGHTY MILES AN HOUR.

Electric Locomotive That Might Have Gone Ninety or More But for a Hot Box—Successful Tests Made.

ELECTRIC TRACTION WITH A VENGEANCE.

NANTASKET BEACH, June 21, 1895.—A hot box on motor car 2502 was all that prevented the New York, New Haven & Hartford Railroad Company from establishing a new world's record for speed to-night.

The heating of the box was due to the fact that the new bearings would not withstand the friction caused by the terrific speed at which the car was run for a distance of probably less than three miles, and in the opinion of men qualified through years of experience in electricity in particular, and speed possibilities in general, was all that prevented a sprint at the rate of 90 miles an hour or better on the rails of the Nantasket trolley road.

As it was the speed attained was, in the opinions of those aboard, faster than they had ever ridden before, and easily 75 miles per hour. In fact, the only doubt was as to whether the speed shown was at the rate of eighty miles. At any rate, it was sufficient to cause men grown gray in railroading to marvel as they had never marvelled before.

The occasion was the trial trip of the electric locomotive, specially geared to run at a speed which should leave all former records in the shade, and the result of the night's work leaves not the slightest doubt that to the Consolidated's new motive power, even at the present stage of development, and in the present form of application, 100 miles an hour is as easy as the maximum speed at which a steam locomotive was ever known to go.

In the matter of speed, therefore, a problem has been settled as well as another, equally important; this is the ability of the new type of locomotives to haul trains, and in a practicable manner. Most of the other questions involved are considered unimportant beside these two.

The test of the flyer was made with the same lack of ostentation and in much the same semi-secret manner as the test of the two other locomotives on Thursday night. All knowledge of what was about to be attempted was again carefully withheld, save from the chosen few to whom it was all important, and the handful of others whose attendance was necessary.

None but officials and attaches of the road were allowed on the car, the entire party comprising less than 20.

Owing to the emphatic success of the trials of the previous night, the party boarded the car with less of apprehension and much more of expectation than on the former occasion. During the afternoon all of the necessary grooming had been carefully looked after, and when boarding the odd-looking car the party felt that they were about to have the ride of their lives.

It was exactly 8:45 o'clock when Col. Heft turned on the current. With an easy motion at first, almost imperceptible, and then with a quick bound, as though an impatient hound were straining at the lash, the car started from the power station and in less than four lengths was going at a speed of 20 miles an hour.

With a look expressive of the confidence which the others felt equally with himself, Col. Heft turned the "controller" another notch, and still another, until, after having traversed less than a quarter of a mile, the car was ambling easily along at a gait of about 35 miles. A stop was made at Nantasket for a few minutes, and then everybody prepared to see the distance to Pemberton annihilated. And it was.

The troublesome curves in the first few rods were gone over slowly, but upon reaching the long tangent just below Nantasket, Col. Heft began to "let her out." There was none of the gradual increase of speed characteristic of the steam locomotive, but with a plunge almost as though hurled from a catapult the car began to fairly devour space.

Faster and faster it flew, everybody within holding on to the nearest object affording a means of support, and conjecturing whether the car could be stopped before plunging into the sea at the end of the route. Less than a minute it lasted, but long enough for a peculiar sensation of exhilaration to take possession of every passenger.

Just as the more apprehensive ones began to wonder how long the car would remain on the rails going at such a terrific speed it was announced that there was a hot box, and Col. Heft, with a satisfied smile at what he had been able to show his passengers, shut off the current. Eighty miles an hour with five notches of the "controller" still to spare was the estimate of the speed at the time of shutting off the "juice."

Under the momentum thus gathered, and on a track on which there was not the slightest suspicion of a down grade, the car ran on for a couple of miles further, the most of the distance at an estimated speed of 60 miles an hour or better.

"How much faster could you have sent her?" Col. Heft was asked.

"Had I given her two notches more we couldn't have remained on the rails," was his reply. He afterward said that 100 miles an hour would have been as easy as the 80 miles. There was not a single doubter, the concensus of opinion being that it was not so much a question of how fast the car could have gone, but how fast it was safe to go.

Director Broker and Judge Hall alternated as motormen on the return. At the power station the car was side-tracked, and one of the two which were run Thursday night was coupled to three of the standard passenger coaches of the Nantasket branch, and weighing 25 tons each.

This was the most anxious moment of either night, but the first turn of the lever dispelled all doubt. With as much ease as when running alone, the motor started off, and despite the additional load was not a whit slower in getting under full headway. The train was run about two miles below Nantasket, and then, returning, engine 769, one of the heaviest locomotives on the division, was coupled to the rear of the train.

The total load now aggregated 175 tons, equal to a train of seven cars, but the ease with which the start was effected, and speed attained and maintained, gave scarcely any opportunity to form a comparison between the tests. Suffice it to say that, to all appearances, the car on a level grade at least could have pulled a load three or more times as great with equal ease.

Vice-President Hall and the others having expressed themselves as more than satisfied, the cars were put away for the night and the party returned by special train to Boston.

The congratulations received by Col. Heft were even warmer than those of the night before, and the whole party somehow could not help but feel that the night's results were destined to mark an epoch in railroading.

From now until next fall statistics which will determine the future of electricity for steam railroads will be carefully gathered, the entire question as to any further extension of the new power by the Consolidated railroad hinging on the result of the season's experiment at Nantasket.—*Boston Herald.*

BARBED WIRE TELEPHONE LINES.

Experiments have been made at Webster City, this state, in using barb wire for telephone lines. In these cases the top wire of the fence was chosen; all breaks were closely mended, and at road crossings an insulated wire was run under ground from one fence to another. The wire was not insulated where connected to the posts by staples. The experimenters had no trouble in talking over a line fifteen miles long. It is believed that before many years every farmer will be connected with his neighbors, and with his market town, by telephone, connection to be had by way of the barb-wire fence. The apparatus is cheap, and the lines are already built.—*From the Shelby Co. (Ia.) Republican.*

This item of living and growing news should have been headed, "Hay-seed science, or every farmer his own electrician."

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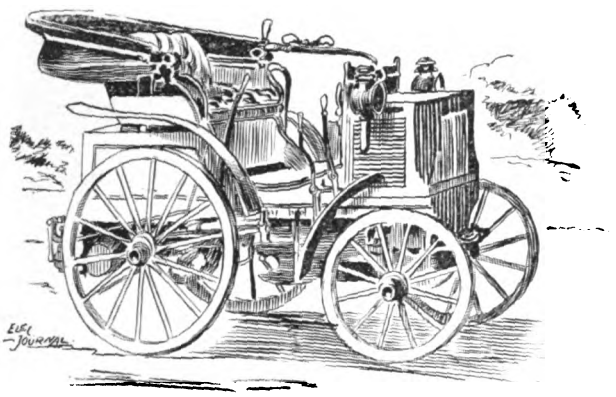
HORSELESS CARRIAGE CONTEST.

In a 750-Mile Race in France Between Vehicles Propelled by Petroleum, Steam and Electricity—The Former Proves to Be the Fastest.

AVERAGE SPEED MADE OF 15 MILES AN HOUR.

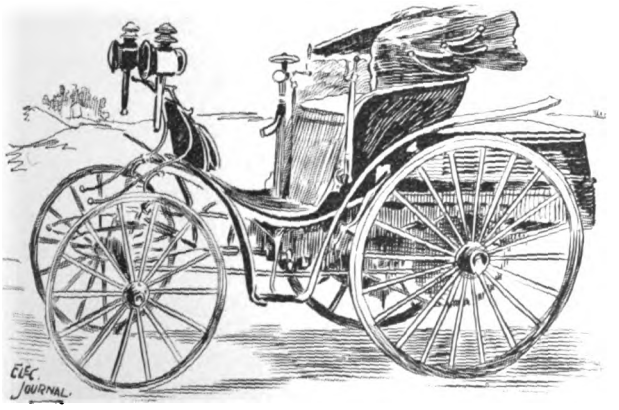
An event in which a world-wide interest has been manifested took place in France on the 13th and 14th of June. It was a competitive test of the efficiency of petroleum, steam and electricity as a propelling power for road carriages. The route covered was between Paris and Bordeaux and return, a distance of 750 miles, and the entries were thirteen steam vehicles, nineteen petroleum



THE PETROLEUM CARRIAGE THAT WON THE RACE.

vehicles, two electric carriages, one steam bicyclette six petroleum bicyclettes and one steam quadricycle. Of these about twenty actually participated. Forty thousand francs was the chief prize and it was secured by a four-passenger petroleum carriage which covered the distance in a little less than 60 hours. A one-seated petroleum carriage made the best time over the course, averaging about 15 miles an hour and received second prize. Steam and electricity failed to make even a creditable showing, break-downs, hot boxes, broken axles, lack of fuel and other misfortunes and drawbacks being attributed as the cause.

The petroleum motors are powerful and compact, while the small amount of fuel required and a device which prevents overheating of the cylinder gives them material advantages. The motors are constructed in three parts, a reservoir containing ordinary petroleum, a carburetor, and an engine with one or two

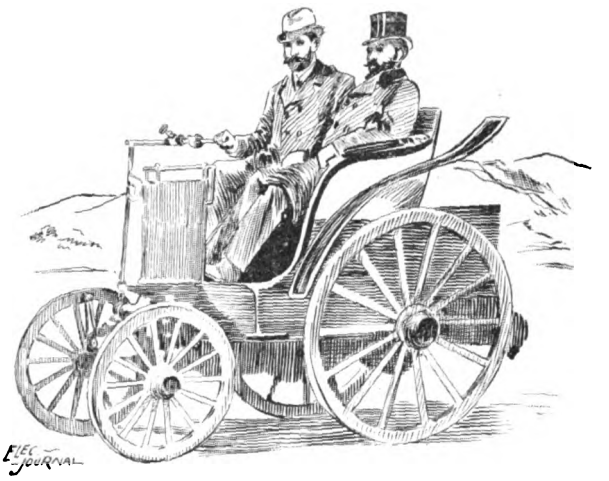


A GASOLINE VICTORIA FOR TWO PASSENGERS.

cylinders. The reservoir will carry petroleum enough for a journey of nearly two hundred miles.

In the carburetor the air is drawn through the petroleum and then passes through a sort of filter which prevents the passage of any liquid. The gases from the air and the petroleum are then rapidly compressed and exploded in a capsule and made red-hot by a flame. The motor works smoothly at a constant velocity of 700 revolutions per minute, and actuates the hind wheels through a friction gearing and a train of wheels that permits of running at four different normal speeds of 3, 5, 7 and 10.5 miles an hour.

Intermediate speeds are obtained through the sliding of a

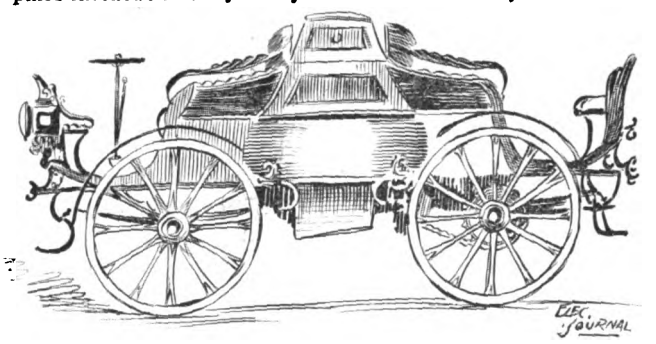


ELECTRIC CARRIAGE FOR TWO.

friction socket manoeuvred by the driver by a pedal. In cases of emergency or on steep slopes the wheels are acted upon directly by means of a block brake within reach of the driver's hand.

A 12 per cent. grade can be surmounted without difficulty and the vehicle can go forward or back at pleasure.

Contestants were permitted to change conductors, but all repairs incident to the journey were to be made by the conductor



STEAM VEHICLE CARRYING FOUR PASSENGERS.

of each vehicle, without outside assistance, and with tools and materials kept in the repair kit of the vehicle.

It is believed that the petroleum carriage will before long make its way into general use as a common means of transportation, taking the place of man's faithful friend, the horse, especially where long continued and rapid transit is required.

ELECTROCUTED.

Dr. Robert Buchanan paid the penalty of law at Sing Sing to-day for the murder of his wife by poisoning, a little over three years ago. As provided by the laws of the State of New York he was electrocuted and a report of the proceedings says that in 34 seconds from the time that the current was turned on he was dead, and adds that, "It was the quickest and most successful execution ever seen in this prison." Electrician Davis was at the switch-board, and at a given signal turned on the current. A voltage of 1,740 was kept on four seconds and then reduced to 40, which was continued for thirty seconds more, at the end of which time Buchanan was pronounced dead.

The last horse car in Philadelphia has retired from business and the trolley reigns supreme. There was a time when men spoke of Philadelphia as slow, but that was weeks ago.—*Chicago Tribune.*

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

VOL. I. CHICAGO, JULY 1, 1895. NO. 3.

Announcement.

THE ELECTRICAL JOURNAL has the pleasure to announce to its readers and patrons that with this issue Professor William A. Anthony of New York becomes a member of its editorial staff. Professor Anthony's ripe scholarship and thoroughly well balanced commercial judgment are too well known to require even mention in this connection, but it may be suggested that in securing the services of Professor Anthony, THE ELECTRICAL JOURNAL gives another evidence of its intention to command for its readers the finished work of the ablest minds in the electrical profession.

* * *

Electrical Equipment of Buildings.

In the wiring of buildings for electric lighting or the transmission of power, the first requisite, assuming that the wire is properly proportioned to the service it is to perform, is *safety*. As contributing to safety the first and most important condition is *accessibility*. This should form the basis of all rules for electric wiring.

In the early days of electric lighting, it was thought that wires covered with a high grade insulation that could be immersed in water for weeks or months without deterioration, could be laid under floors or fastened to brick walls and covered with mortar, and would do service indefinitely. Experience has shown that it is impossible to rely upon the absolute permanency of any insulation, that under the most favorable conditions insulation may sometimes fail, or wires burn out from some accident, and repairs become necessary. To secure accessibility, conduits were introduced, into which the wires could be drawn, and withdrawn in case of necessity. After a little experience it was found necessary to protect these from mechanical injury by an armor. Hence was involved, first the brass-armored, and then the iron-armored conduit. This last is ordinary wrought iron, gas or steam pipe with an insulating lining. This lining, however, is not an absolute insulator. It is not, and could not be made, except at an expense that would be absolutely prohibitory, impervious to moisture. As a protection to the wires against mechanical injury, as a runway in which wires may be drawn at pleasure and from which they may be withdrawn and replaced if necessary, it is all that could be desired, but it is not an insulator. Wires used in it must be as well insulated as though to be placed in mortar or submerged in water. The interior lining serves, therefore, only as an additional mechanical protection, preventing injury to the wire from fins or burrs in the iron pipe as it is drawn into place. If the pipe were made with sufficient care, thoroughly cleaned from all internal projections or roughness, and care were taken in the installation to remove all burrs and sharp corners, there would be no more danger of injury to he wire than in the lined pipe, and there would be no advantage of the lined over the unlined pipe, while the latter would have the advantage in cost and smaller external diameter.

The saving in the cost of an installation by the use of the plain iron conduit would be considerable, and there is no question that a suitable pipe could be had, if the fire underwriters would approve its use.

One objection to iron pipe is the action set up by alternating current, but this is the same for the lined as for the unlined pipe, and is almost wholly obviated by placing both conductors of a circuit in the same tube, especially if these are twisted together or are made in the form of a concentric cable.

It would, of course, be a great gain if a conduit could be produced that, besides offering the advantages of the iron pipe, was at the same time a perfect insulator, permitting the use of bare wire or cable, and it would be a still further gain if it were at the same time flexible and could be easily bent around corners or obstacles in its path; but such a conduit is not forthcoming. Let it be remembered then that the conduit only serves as a mechanical protection and a runway, and that for insulation, reliance must be placed upon the covering on the conductor, and it will appear that nothing now available, considering cost and other advantages, will serve the purpose better than iron pipe.

Again we would urge that safety in a wiring installation demands accessibility. If a defective wire can be readily replaced, the chances are that it would be replaced before any serious damage had resulted. To our view there is no form of installation admissible between the moulding or conduit that is accessible throughout its length, and the concealed conduit affording protection equal to that of iron pipe, so installed that conductors can at any time be withdrawn and replaced.

* * *

Good Judgment in the Practice of Electrical Engineering.

In the older branches of engineering, experience has accumulated to such an extent that good examples of nearly every phase of practice are readily accessible. It is true that every particular engineering problem must have its own special solution; but in solving their problems mechanical and civil engineers may keep more closely to a beaten path than is possible with the electrical engineer. Good judgment is essential in the design of any engineering structure, but it is relatively less important in those branches in which so many examples may be utilized in forming a judgment as to plans and methods than in one where such examples are largely lacking.

Electrical engineering practice runs back scarcely more than ten years. The applications of electricity on any considerable scale at an earlier period were mostly experiments conducted with insufficient data, and largely at the expense of the public.

The rapid rate of evolution in the industrial applications of electricity on a large scale has compelled the electrical engineer to base his plans on foundations that were known to be rapidly shifting. Hence the unusual demand made upon his judgment in choosing the best system and in adopting those

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new methods which promise the greatest success and permanency.

Four years ago direct connected machinery in this country was confined to large central station plants and to a few railway generators. The direct connected machinery exhibited at the World's Fair doubtless stimulated the adoption of this method for smaller units. Now almost nothing else is allowable. A plant installed four years ago on the lines of the best practice prevailing at that time is now out of date, though it may be doing just as good service as the day it was started. Such rapid changes in electrical engineering practice demand unusual alertness, native tact, and the good judgment to appropriate to one's uses the latest departures which promise to be generally adopted.

It is difficult to forecast the future and to anticipate the actual changes likely to take place. The most notably impending advances do not appear to be in electric lighting, but in the transmission of power. Long distance transmission is perhaps no nearer now than two or three years ago; but the subject is likely to assume a new aspect with the opening of the Niagara Falls plant. There are vast fields in the western mining regions where water power may be utilized for mining purposes. Only a beginning has been made. In too many cases the engineer has not understood both sides of the problem involved, viz., how to transmit power electrically, and how to put it to the exact uses required at the mines and in the processes of concentration and reduction. The resulting failures have served only to delay applications in this most important field.

Multiphase transmission is a most enchanting field. Its vast difficulties are equalled only by its vast possibilities. Advances in this field have been delayed perhaps by some fundamental misconceptions relating to the rotary field and to the precise operation of both synchronous and induction motors. These now give promise of satisfactory solution, and the growing electrical engineer will do well to keep an eye on alternate current transmission.

Good judgment is native rather than acquired; but much can be done to improve and develop a brilliant native gift even. The two things most essential to this process of development are training and experience. It is not the part of wisdom to exalt training above experience or experience above training. Both are essential to the highest success. An engineer can not be too well grounded in severe mathematics and theory. A thorough engineering course is the best foundation for subsequent experience to overlay with the fine finish of the practiced engineer.

Henry S. Carhart

* * *

Does Electricity Kill?

The lay press will make much of the story that comes from Rochester, of the electrical worker who received 3,000 volts of electricity, and who was resuscitated after a half hour of unconsciousness. It will be noticed, however, that all the telegraphic accounts of the affair lay particular stress on the work of the doctors, the feelings of the victim, etc., in fact the sensational part of the story lacks none of the details likely to sell "space matter." But such unimportant details as the kind of current, the statement of at least one reputable witness, or even the victim, that he actually got 3,000 volts, the time of duration of the shock—all these details are left to the imagination. There is not even the lone statement as to how the man got the shock, in what way he got it, whether from the machine, from the line, or from a leak. The great probability is that he got part of the voltage of a high potential machine, and that the contact covered an infinitesimal period of time—which by the way, makes a good deal of difference.

Before any serious credence is given to the story, the details ought to be at hand. It is not a light thing to set aside the careful, pains taking, and certainly scientific work that has been done at the New York penetentiaries by the physicians detailed for the purpose. It may be all well enough for those who know nothing about physiology to give an ear to George D. Burton's rubbish, but the medical man must decide either that Dr. A. H. Goelet was guilty of direct falsification in his report on the autopsy of the electrocuted criminal Hampden, or that electricity, as administered under the New York law, kills, and kills instantly. According to Dr. Goelet's report, that negro's brain organism was as completely destroyed as though his head had been shot away by a cannon ball. The only question in all this, it seems to us, hinges on the word "instantaneous." We all know that anticipation is one of the keenest pleasures, or the greatest agony of which the human mind is capable, and it is to be supposed that the anticipation of an event as momentous as a seance in a death chair, would bring with it the most intense horror, and the wonder is that the very suspense of the thing does not often cause death by heart failure or apoplexy.

Even admitting, for the sake of argument—and we admit it for no other reason—that death by electricity is not instantaneous and painless, the actual physical suffering cannot possibly approach the mental distress of the preceding moments.

The only thing really of interest in connection with the Rochester case, or that means anything, is the statement of Grover that he felt not the slightest pain during the whole period following the shock.

* * *

Bury The Wires.

In all large cities there is an agitation going on at the present time in the direction of burying telegraph, telephone and electric light wires, and of adopting the conduit or other underground system for electric cars instead of the overhead trolley. It is a move in the right direction and should not only be encouraged and helped along, but if necessary a little pressure should be brought to bear. Excuses which have done service for a number of years and which were more or less valid, do not carry with them the same weight today that they used to do. Until a satisfactory underground system was devised which would do away with the overhead trolley, the latter was a necessary evil, and the unsightly—not to say dangerous—wires had to be put up with. There are several systems now, however, which obviate the use of the overhead trolley, and no time should be lost in bringing about a change. Telegraph and telephone wires too can be operated with every facility underground, and the unsightly poles should be removed. It is an encouraging feature that the companies interested are one by one falling into line, and in some instances are the first to make application to bring about the change. The time is not very far distant, we believe, when in order to get an electric shock from wires it will be necessary to take a pick and shovel and dig below the surface. The most wholesome sign in regard to this reform, is the current news that at least two of the large manufacturers are working on underground conduit systems for railway purposes.

* * *

Economy In Arc Lighting.

In another column will be found an article of special value to central and isolated station managers on "Economy In Arc Lighting," by Mr. W. F. White, Manager of the New Omaha Thompson-Houston Electric Light Company. Mr. White is abundantly able to write authoritatively upon commercial practice appertaining to light and power stations, and we regard his utterances as especially timely just now when the electrical business in all branches promises so well, and when those who are engaged in it, are studying ways and means to recoup from the disastrous period of depression just passed. The science of electricity has gone forward so rapidly during the past few years, that the finances of its friends have in a measure been lost sight of. In surrounding itself with an editorial staff of the ablest men in the profession, the strong incentive of THE

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ELECTRICAL JOURNAL was the desire to benefit those engaged in commercial electricity by helping then to solve some of the difficult problems that have stood in the way of good dividends. If Professor Carhart's editorial shall be the means of arousing a wholesome discussion and investigation along these lines, THE ELECTRICAL JOURNAL will be abundantly repaid for its endeavors.

* * *

Brooklyn Trolley Murders.

The presidents of the Brooklyn trolley lines are preparing to fight the ordinance which commands them to equip their cars with fenders for the protection of the public. They complain that there is no fender yet devised which will do what it is made for. These people were given two months in which to prepare to obey the ordinance, and they knew by one of its clauses that they would be subjected to a fine of $25.00 for every car turned out of the barn after the law went into effect. We happen to know Mayor Schieren, and we believe he meant every word, when he gave final notice to the presidents last week that "unless the ordinance was complied with prosecutions will follow." The three hundred or more cars run in Brooklyn will net the city some $7,500 a day in case of failure on the part of the railway people to obey the law. A very few days of such expensive bullheadedness and reckless disregard of the lives of people will have a most salutary effect. Moreover, the sooner these people are made to stop their wanton murders the better it will be for electric traction. Brooklyn's murder record is flaunted in the face of every company asking for an electric railway franchise.

* * *

Electrical Service In New York.

"It is to be regretted that before the telephone companies were permitted to stretch wires in New York they were not required to give free service of their instruments to officers of the Police and Fire departments on duty. It often happens that when a police patrolman wishes to send for an ambulance quickly he is obliged to hunt around for a telephone subscriber before he can communicate with a hospital.

In the absence of a law or contract compelling the telephone companies to give free service to the city's officers the Board of Police Commissioners ought to make an agreement by which the police will be authorized to use the public telephones whenever its use is necessary. The cost would not be great compared with the advantage of having this means of communication."—*New York Herald.*

This item is of special interest in this issue of THE ELECTRICAL JOURNAL in that it affords an opportunity of comparison between the public service in New York and Chicago. The paper by Mr. Barrett in another column gives the Chicago side.

* * *

In another column will be found a report from the Pennsylvania oil fields. Day by day the output grows less, and it does not require the gift of prophesy to predict that the time is not far distant when fuel users will have to go back again to coal or find a substitute. When this time comes, what substitute so likely to meet all the requirements as electricity. It is a difficult thing for a progressive people to go back to something once discarded, and in many places, and for many purposes, coal has been abandoned. In the far west, where mining property has either been abandoned for want of fuel to work it, or foreign fuel has been utilized, the dearth of oil will be felt first. Inevitably the price of coal will depend somewhat on the supply of oil. Miners least of all can bear an advance in the price of fuel. All this means eventually a commoner application of water power which must bring with it electric transmission. "It is an ill wind that blows no one any good."

The Washington authorities have set the ball rolling by ordering the Eckington and Soldiers' Home Railway Company to operate its cars after July 1st, by other power than the overhead trolley. This means either cable or conduit trolley, and as the road is now fully equipped electrically, there is no question that the conduit trolley will be more economical than the cable. They do these things differently at the Capital City than in other towns, and in all human probability, the railroad officials will do as they are bid or be made an example of. The plea made two years ago by this company that there was not a feasible electric system other than the overhead trolley will scarcely be accepted as valid at the present time.

That truly good and godly city Philadelphia, is burdened with a carbuncle on its back in the shape of an electric trust. "Hog Combination" is the mildest language used by its purveyors of news, to characterize the propensities of the aggregation of gentlemen who sacrifice their time and money to help light the way of holy quakers through this vale of sorrow. And yet this "Hog Combination" is made up of Philadelphians.

The Rochester young man who intercepted some 3,000 volts of current the other day says the last thing he remembers is that he was standing near a dynamo and—the next instant he thought he was an angel. Did he think the dynamo was a sort of Elijah's Chariot, or does electricity make people angelic. Some late residents of Auburn and Sing Sing would probably testify to the latter if they could.

Once, when we were a small boy and lived on our father's farm, we attempted some playful badinage with what we subsequently ascertained to be a skunk. We swapped a new suit of velvet clothes with silver buttons, for some experience which has done good service ever since, and we will never again be drawn into controversy with that sort of an animal—even of the journalistic breed.

Coming back again by way of China is the hollow yet persistant voice of George D. Burton demanding to be allowed to demonstrate that electricity does not "electrocute." The question that forces itself to the front is, who is interfering to prevent the gentleman from seeking the truth even at the dynamo's mouth?

"The Yerkes telescope, they say, will bring the moon within fifty miles of the earth."

"That's bad for the moon. The Bell Telephone Company will nab it, sure."—*Chicago Tribune.*

But how the Tribune's circulation will boom when the lunatics are connected with the earth. They will find the great Chicago daily a paper just to their liking.

It is scarcely news to announce that the Niagara tests made on the 25th, were successful. Three thousand horse power was developed under circumstances that leave no room to doubt that the maximum of 5,000 can be counted on, as called for in the plans for the present installation.

The item going the rounds of the daily press headed "Kinsman to Cleveland," does not refer to a relative of the President. It is simply the announcement of a trolley line from Kinsman, Ohio, to Cleveland.

If there were a law to make every man give a bond to back his utterances, or if there were fewer hats with holes through them, there would be fewer people talking about $50.00 a year arc lights.

Why that inactivity and sluggishness at Schenectady and Lynn? The General Electric hasn't "moved" for more than a week. Or is it the correspondents who are not keeping vigil?

If the courts keep on, Berliner will be dragged into fame in spite of himself. We never heard of the Jarndyce family until they had a law suit.

An article on the sinusoidal current, which was promised for this number is unavoidably held over until next issue.

The trolley line must be handled by a Jehu. It has driven the street car horse into the butcher shop.

Litigation is a leak on the line, and the lawyer lights his lamp from the wasted current.

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ELECTRICAL AIDS TO LEGISLATION.

This is an age of electrical push. Instead of calling a page by the old-time custom of clapping the hands, the representatives in the fifty-fourth congress, which meets next December, will find on each desk an electric push-button with which to summon the loitering and dilatory messengers. If the page is really a good thing he should be pushed along, and if the innovation results in turning over a new page occasionally, so much the better for the people. As this is the age of electrical progress the eternal fitness of things cannot be better conserved than by putting a drowsy and indolent legislator on a live wire connection.

The old style of clapping the hands when a page was wanted was a pernicious habit. It filled the newspaper reports of the platitudinous caterwaulings of windy lawmakers with "(applause)" and by it many a tiresome old blatherskite was spurred on to renewed assaults upon the queen's English and a tedious recitation of rhetorical idiocies.

But we hope that this application of electrical energy to the proceedings of the national legislature will not end with the push-buttons for pages. The great public that pays the bill for this yearly exhibition of oratorical athletics should have a push-button that would close the doors and adjourn congress when the people get tired. There ought to be a new bureau created to be called the "department of electrical push-buttons," the head of which should have the power to call down the perpetrator of a long-winded harangue and shock him with about 400 volts. A charge of about 800 volts would be the proper thing for a representative who persisted in calling a colleague a liar, and speedy electrocution should be the penalty for calling an antagonist a thief.

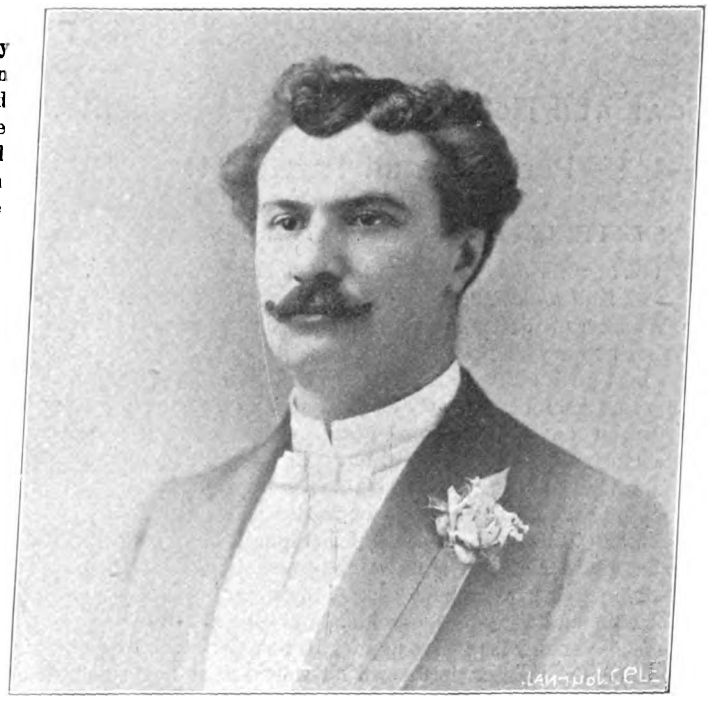
A switch board and signal system might be arranged whereby the speeches of members could be regulated by the push-button department. Three short, sharp shocks might mean, "you are very dry"; two short pushes, "you are getting on dangerous ground"; one long push, "you have been eating cucumbers, finish when you get sober"; two long shocks, "you are making a long-eared jackanape of yourself."

The proper application of the principles of electrical energy to the processes of national legislation should be encouraged. Our legislatures have been insulated too long. A ground-wire connection with the battery of public opinion might be productive of a greater degree of circumspection in the conduct of our public servants.—*Chicago Times-Herald.*

MUNICIPAL LIGHTING.

"I think that the city can produce electric light as cheaply as any private concern and without paying dividends and interest upon bonds," said Superintendent John P. Barrett, of the city telegraph and electric department lately, while discussing the proposed purchase of the Hyde Park Electric Company's plant by the city. "Should the city supply light as it does water, cheaper than the corporations do, it could make millions. If the city goes into the lighting business this department would become self-sustaining—in fact, it would be a mint for the city. Coal could be bought very cheaply, there would be no exorbitant rents to pay, no gilt-edged salaries and no drones. One of the highest salaries paid is that of the chief engineer, $100 per month. Of course laborers on our eight hour a day shift plan would cost the city more than they would a private corporation, but that item would be more than counterbalanced.

"The city paid $60,000 for equipping an electric plant on the West Side and sold it to the Metropolitan 'L' company for $110,000. With the proceeds we are now erecting one of the most modern plants in the world at Blue Island avenue and Halsted street. We now light the downtown district with the money that formerly went to the gas companies. As we are not allowed to sell light to private individuals we have about six miles of wire to each 2,000 arc lamps. Private corporations would tap the wires, of course, at frequent intervals. This department would not ask another cent of appropriation if the city would go into the electric light supplying business."—*Chicago Post.*



JAMES J. WOOD.

James J. Wood, the electrician and mechanical engineer of the Fort Wayne Electric Corporation, and who is well-known in electrical circles, was brought up in New York City until the age of 11 years, when with his parents he moved to Branford, Conn., and entered the employ of the Branford Lock Co., where he remained for seven years. In 1874 he moved to Brooklyn to learn the machine and tool making business serving there for three years. The next four years he spent in attendance at the Brooklyn High School from which he graduated with honors as a mechanical engineer and draughtsman. In 1876 he became acquainted with J. B. Fuller, whom he assisted in the construction of electrical machinery, and in 1877 they together succeeded in operating and exhibiting six arc lights in series from a Fuller machine. In 1879 Mr. Wood brought out his first dynamo. It was capable of running either one large light of 2,000 candle power or three smaller lights from three independent circuits. In 1885 being then associated with the American Electric Manufacturing Co., he designed the arc lighting machinery for the Statue of Liberty in New York Harbor and the machinery is still in use. In 1888 he took charge of the manufacture of electrical apparatus for the Fort Wayne Electric Co., now the Fort Wayne Electric Corporation, and has invented and constructed for them a complete arc lighting system with all its details, including cut-outs, lightning arresters, instruments, etc., and constant current dynamos varying in capacity from 1 to 125 lights, as well as arc lamps for every known purpose, 46,000 of these lamps having been sold in the past four years.

Mr. Wood's latest work has been on alternating current machinery of which he has designed a system of alternators which vary in size from 750 to 6,000 lights capacity. Also a series of transformers varying in size from 300 watts or 6 lights to 25,000 watts or 500 lights. Mr. Wood is but 39 years old and hence still in the prime of life, and much may yet be expected of him.

FIRST GET YOUR DIAMOND.

An inventor has devised an electrical apparatus by which it is possible to test whether one's diamond is the genuine article or a base and spurious imitation. The diamond is moistened and slowly moved toward a small, thin disk of aluminum, which is rapidly revolved by an electric motor. The contact of the diamond thus constitutes a break to the motion of the disk. If metallic marks are found on the supposed gem, it is not genuine; otherwise, it is a pure stone. The idea is based on the fact that if a sharp piece of aluminum be rubbed on moistened glass, brilliant markings appear, but the phenomenon is absent when similar contact is made with a diamond.

They are making glass bricks now—perhaps to throw at people who live in stone houses.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students.

Personal and Pertinent.

A SIMPLE EXPLANATION OF THE STORAGE CELL.

(Written for the Scholars of the National School, by Dr. Paul Radenhausen, Instructor, Davenport Class.)

Whenever two elements unite, energy in some form is set free. Carbon and oxygen unite to form the well-known carbon dioxide. The heat produced by this chemical reaction is one of our principal sources of heat supply for heating and cooking purposes. Hydrogen and oxygen, two gases, unite with tremendous force to form our common water. Under ordinary conditions this water is an exceedingly stable compound. It is possible though to effect a disturbance among the molecules of this combination. Whenever an element is brought into contact with water whose chemical affinity for oxygen is greater than that of the hydrogen, a decomposition of the water is effected and the elements unite with the oxygen and liberate the hydrogen. Here also energy is set free as may be seen whenever a piece of the metal potassium is thrown on water. The heat generated will immediately melt the potassium which being lighter than water will float, hydrogen being liberated. The burning gas seen in this experiment is the hydrogen, as the following formula readily demonstrates:

$$K_2 + H_2O = K_2O + H_2.$$

Several metals will thus decompose the water, while some act only at higher temperatures, or in the presence of some other substance such as an acid.

Many erroneous expressions are in common use to explain this simple reaction between zinc and dilute sulphuric acid, "The acid decomposes the zinc," for instance, the experimenter forgetting that zinc is an element which cannot be decomposed into simpler substances. The reaction is exceedingly simple and for the benefit of the scholars of the National School who may not have had a thorough education in chemistry, I wish to explain this matter fully. As stated before potassium decomposes water and liberates hydrogen.

So does zinc:

$$Zn + H_2O = ZnO + H_2.$$

Only in the case of zinc we need the assistance of an acid. If the process is allowed to go on for awhile we shall find the liquid warm—thus showing that here also heat is set free. Both Volta and Galvani discovered that in these processes, not only heat is set free, but also another form of energy which we call electricity. The different methods of demonstrating the presence of this peculiar force I need not discuss here. You are all familiar with the experiments.

The conclusion I wish to draw now is this. Whenever an element unites with another element, either in the free state or in a combination, some form of energy is set free. If this chemical combination involves a decomposition of water then it is possible to conduct this form of energy, electricity, from the seat of the chemical reaction. It is a well known fact that Bimsen's method of overcoming polarisation in the cell, is based on the fact that the hydrogen is oxydised at the moment it is liberated. By this most powerful chemical reaction a ready supply of electrical energy is obtained. In order to avoid errors I wish to repeat: the action of the Bimsen cell is based upon the two chemical reactions (oxydations) that takes place. First, the union (oxydation) of the zinc and oxygen of the water and second union (oxydation) of the hydrogen and oxygen, derived either from the nitric acid or the chromic acid.

These same processes take place constantly with the greatest economy in the human body and in the entire organic world. Here we find the sources of the supply of heat and electricity in the organisms. This wonderful economy should always be the type of the experimenter in his attempts of utilisation of energy. The time is probably not far distant when the electrical energy that is formed in all processes of combustion (oxydation) will be utilized.

We have seen that the decomposition of water by metals is accompanied by a liberation of electrical energy. This electrical energy has the power of decomposing water in its constituents:

$$H_2O = H_2 + O.$$

This simple reaction is the basis of the so called storage battery.

Mr. Wm. Michaelson of the Omaha Class has become the sole proprietor of the Central Electrical Works and is doing a large amount of work on transformers.

Charles L. Pillsbury, city electrician of Minneapolis, and instructor for the Minneapolis classes, is preparing the plans and specifications for a complete electrical equipment for the Soldiers' Home at Minnehaha.

Mr. Edward Schurig, City Electrician of Omaha, and a member of the Omaha Class, has succeeded by his vigorous and well directed efforts in reducing during the last five months, by 218, the number of poles on the city streets.

The Omaha Class, in appreciation of the instruction thus far provided, recently passed resolutions by a unanimous vote commending the course and expressing satisfaction at the manner in which the representations made during organization have been carried out by the School.

Chief Electrician Cabot of Cincinnati who is a member of one of the National School classes in that city has been invited by a lady resident of Barr Street to spend an evening at her house to feel how pleasant it is to have the "bugs crawl all over him." It may be well to explain that the bugs referred to are insects attracted by an arc lamp which proudly rears its head high in the air directly opposite the aforesaid lady's door. Pleasant evening, Brother Cabot!

Edward T. Pardee of the Omaha Class was in Chicago for two or three days last week. Mr. Pardee is the engertic representative in Iowa and Nebraska of the Fort Wayne Electric Corporation. All Mr. Pardee wants at any time is an inkling of somebody's intention to install a lighting plant within the bounds of his territory and the first train leaving Omaha in that direction is none too soon for him to take. The motto which governs his action in the interests of the corporation he represents is that "eternal vigilance is the price of success."

Quite a pleasant incident occurred in Columbus Class No. 1 at its meeting last week. After the lesson was concluded, President John Kane of the class arose, and in a neat speech of ten minutes, presented the instructor of the class, Mr. James E. Boyd, with a handsome gold watch and chain. It was the occasion of Mr. Boyd's farewell to the class. He leaves Columbus for a season of post graduate work at Cornell. Mr. Boyd has been for quite a time assistant to Prof. B. F. Thomas at the University of Ohio. Mr. N. H. Brown, Prof. Thomas' other assistant will take Mr. Boyd's class as well as his own for the remainder of the session.

Announcement.

A large percentage of the students of the School have already subscribed for THE ELECTRICAL JOURNAL, thus confirming the judgment of its management in the selection of its contents. With each number of the paper, the character of its reading matter will improve, as every effort is being made to secure contributions from the most capable men.

For the benefit of those who were very late in getting the first number of the journal, the subscription price to students will remain at $1.50 until further notice.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

The newly organized Telephone Protective Association will hold its next meeting at Niagara Falls on Sept. 1.

An automatic telephone service is to be introduced into Syracuse, N.Y., if a franchise can be obtained, which is probable.

The Central District and Printing Telephone Company will construct a new line between Pittsburg and Washington. It will be a metallic circuit.

The telegraph and telephone companies of Philadelphia have made application to use the city's conduits for the purpose of placing their wires underground.

Henry C. Strong of Chicago, claims to be the original patentee of the telephone receiver, having filed his application in Mexico in 1881. He will contest the rights of the Bell Telephone company in the matter.

In England the telegraph is operated in connection with the mail service. Messengers may be sent to any part of the Kingdom at the rate of 12 cents for 12 words which includes delivery within one mile of a head office or within the postal limits.

The head office of the Postal Telegraph Company in Chicago will in a few days occupy very commodious quarters in the new Stock Exchange Building. The public office will be on the main floor, and the operating room will occupy the entire thirteenth floor. A large sum of money is being expended with a view to providing every convenience to facilitate business and the Chicago branch will have one of the best equipped offices in the country.

Light and Power.

Chicago is adding to its municipal lighting plant by the erection of a new station, the present capacity of which is 800 arc lights of 2,000 candle power each.

Modale, Ia., has decided to instal a municipal plant, and is soon to purchase a 500 or 600 light alternator, with necessary station equipment, transformers and other material.

Falls City, Neb. which is now operating a Brush 2,000 volt alternating system has decided to increase the plant capacity, and is now in the market for a complete station equipment.

The Niagara Falls plant for the distribution of electric power has commenced operation, and what was to some extent an experiment on a large scale, is now an assured success on an equally large scale.

The new American liner, St. Louis, has over eighteen miles of wire in use for lighting and motor purposes. A new device is to be tested on the same vessel whereby, upon an indication of danger, all the bulk heads can automatically close at a moment's notice by simply pulling a lever.

In the residence districts of Cincinnati opposition to the arc lamp for street lighting purposes is urged on the ground that it "attracts bugs." One resident asks the board of Aldermen to have the globe in front of her house painted "so the light will not shine in our faces and bring all the bugs on us."

Pawnee City, Neb., is about to enlarge its municipal plant. As the town's prosperity depends on the farmers, the City Council recently instructed the Electric Light Committee to make a contract for apparatus "if it rained within six days." The rain having come in the time prescribed, an award will doubtless soon be made.

A bill will be presented to the next session of Congress providing for an appropriation of $750,000 to establish an electric plant at the Great Falls of the Potomac where it is claimed enough electricity can be obtained for the uses of the government in Washington to more than compensate for the entire outlay in a little over a year's time.

Toledo, Ohio. will place its telephone and electric light wires underground. The aldermen, in order to obtain an intelligent idea of the practicability of an underground system made a trip to Detroit where conduits are in successful operation and were so pleased with what they saw that they at once passed ordinances providing for an underground system.

The Westinghouse Electric and Manufacturing Company has commenced to drill for gas on the land occupied by the company at East Pittsburgh. A 25 horse-power motor is used to work the drill instead of steam, the current being supplied from the works. The new motive power for well drilling is being watched with a good deal of interest, in the hope that great economy will be the result.

There is much interest in Duluth, Minn., in a proposition to take advantage of the water-power of the St. Louis river, in order to supply the locality with the electric current in unlimited quantity. It is hoped for one thing, to make it practicable to smelt iron ore by electricity. Should such hopes be realized, it would result in the locating there of many enterprises, where projectors would perceive the necessity of reaching the trade of the vast surrounding country in that way. The Minnesota Canal Co. and the Altamont Light and Power Co., are the two organizations now struggling for possession of such franchises as are necessary to control the situation. The plan is to dam the St. Louis river about 20 miles above Duluth. Duluth people think there is a possibility of the scheme rivaling if not exceeding in magnitude, the Niagara enterprise.

Railways.

An electric car line will soon be built between Cairo, Egypt, and the pyramids.

An electric double track road thirty-five miles in length will be built from St. Louis Mo. to Morse's Mill.

The recent electrical equipment of the Baltimore and Ohio railroad tunnel, at Baltimore, constitutes it the first electric underground system in America.

A Survey has been made between Neillsville, Minn, and La Crosse, a distance of 90 miles, with a view to building an electric line between the two points. It is proposed to obtain the power from the Black River Falls.

At a recent test of an electric locomotive on the Nantasket Beach division of the New York, New Haven and Hartford Railway, a straight away stretch of three miles showed an average speed at the rate of eighty miles an hour.

The Transcontinental Electric Railway, it is said, is an assured enterprise. The intention is to build an elevated electric railroad from New York to Chicago for the present, and, later on, carry it through to San Francisco. The engineering difficulties can readily be contended with, and ample capital is available to carry it through.

An electric railway is assured between Brazil and Terre Haute, Ind., with a half way station at Knightsville. It will be essentially a freight road, used to carry provisions and coal, to and from the mines. The coal cars will be so constructed that they can be run on to wagon trucks without unloading, and hauled about the town for delivery of coal.

A sabbatarian enthusiast, in the person of Recorder Willet of New Orleans, seeks to take advantage of a technicality to prevent the running of electric street cars in that city on Sunday. A city ordinance permits the running of steam and horse cars but makes no reference to electric cars. Recorder Willet would seem to be operating on the principle that "the end justifies the means."

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A statistical fiend has been at work in Chicago to figure out the saving of time made by the use of the electric as against the old horse cars formerly in operation. He has confined his calculations to the south side only, being one of the three great divisions of the city. His conclusions are that the saving is equivalent to 10,000,000 hours in a year, or 1,250,000 eight hour days. It means the time of 4,166 men working through a 300 day year.

The Lake Street Elevated Railway, in Chicago, is preparing to substitute electricity for steam on its line. This will make the second elevated road to adopt this form of motive power, and it is probable that others will soon follow. The Lake street road has contracted with the General Electric Company to make the change at an expense of $100,000, and the new system will be in operation at an early date.

General News.

Sacramento, Cal., will hold an electric carnival during the first week of September.

Complaint comes from Troy, N. Y. that the electric current is destroying the shade trees of the town.

Prof. H. W. Vannel of Chicago says electricity is a cure for insanity and he asks for permission to experiment upon the patients of the County Asylum. The matter has been referred to the Public Service Committee by the County Board.

The following utterance is attributed to Mr. Westinghouse: "During the next 12 months the development of electricity as a motive power will be more startling, on a greater and more comprehensive scale, more suggestive of the remote possibilities of the use of electricity for commercial purposes, than all the developments in recent years put together."

The Weston Electrical Instrument Company of Newark, N. J. finding their present quarters too limited for their rapidly growing business, have purchased another site lying between Waverly Park and the Pennsylvania Railroad depot consisting of forty-eight acres upon which they will erect a large steel and brick structure together with a number of cottages for their workmen.

The amount of capital engaged in the electrical business, not including telegraphy, is estimated as follows: England, $100,000,000; France, $150,000,000; Germany, $200,000,000; Austria, Italy, Spain and Switzerland, $180,000,000; Russia, Sweden, Norway and Denmark, $50,000,000; the United States, $450,000,000; Canada and other American countries, $50,000,000; making a total of about $68',000,000 in Europe and $500,000,000 in America.

Personal.

Prof. Henry S. Carhart and Jesse M. Smith, of Detroit, have been selected by the Public Lighting Commission to make the tests on the dynamos and lamps of the city plant of Detroit. They are required to determine whether they meet the requirements of the contracts. These tests will be made at once. Both gentlemen have been employed from time to time by the Commission as consulting engineers on this plant. The lighting is so far giving excellent satisfaction to the citizens of Detroit.

It is currently understood that Professor F. B. Badt is to be the executive officer of the Siemens & Halske Company under the new board of directors to be elected early in July.

Messrs. Meysenberg and Wright have demonstrated their ability to handle large affairs since the great German Company set foot on these shores and those who know Professor Badt are persuaded that they will make a wise business stroke when they entrust him with the execution of the Company's interests.

There were several deaths from natural causes in Brooklyn yesterday. It is impossible for the trolley cars to do it all.—*Rochester Union.*

ECONOMY IN ARC LIGHTING.

BY W. F. WHITE.

Prof. Carhart's interesting editorial under the above heading in your issue of June 1st, gives some facts as to the value of cored carbons, which suggest the advisability of the general adoption of this class of carbons. Experiments made by the writer have given the same results, viz.: that the same light will be given from cored carbons with ten per cent. less watts than from ordinary solid carbons, or that fifty-five lights may be operated from a fifty light dynamo without increasing the watts output above the requirements of fifty lamps burning solid carbons, the amount of light per lamp in each case being the same.

With a given number of lamps in use, the watts output of a station would therefore be reduced ten per cent. by the use of cored carbons. The operating cost would not be reduced in the same proportion, however, as the coal bill is the only part of said cost that would reduce in direct ratio. The coal bill in most stations of considerable size varies between ten per cent. and twenty-five per cent. of the total operating cost, (interest charges omitted) varying with the character of plant, and the quality and cost of coal. A deduction as to the saving effected by the use of cored carbons, based on a reduction in operating expenses in proportion to the watts output, would therefore be very misleading.

There are three items of cost that vary directly with the kind of carbon used, namely: the coal, the carbons, and the labor of trimming. Below are some figures on these costs with different carbons, all based on the same candle power per lamp (nominal 2,000 c. p.)

To make the difference in favor of the cored carbon as great as possible, an extreme cost of coal per lamp hour of $.0048 for solid carbons has been assumed.

The long life carbons mentioned are carbons that have been on the market for some months, and are in general use. They cost more per thousand, but about the same per lamp hour, as compared with the ordinary solid carbons.

The costs given below are from actual tests in commercial work, and will be found closely approximate as a general average.

GOOD SOLID CARBON.

Cost of coal per lamp hour	$.0048
" carbons per lamp hour	.0017
" labor trimming per lamp hour	.0021
Total cost above items per lamp hour	$.0086

GOOD CORED CARBON.

Cost of coal per lamp hour	$.0043
" carbon per lamp hour	.0025
" labor trimming per lamp hour	.0021
Total cost above items per lamp hour	$.0089

GOOD LONG LIFE CARBON.

Cost of coal per lamp hour	$05 48
" carbon per lamp hour	.0017
" labor trimming per lamp hour	.0013
Total cost above items per lamp hour.	$.0078

From these figures it will be seen that while there is a saving of about ten per cent. in the cost of carbon burned, in the boiler, by the use of cored carbons, the saving is more than compensated for by the increased cost of the carbon burned in the lamp. The cost of labor of trimming is the same in each case, as the life of each kind of carbon is about the same.

As compared with the long life carbon, the cored carbon shows the same saving in coal, but is much more expensive in the other two items. The difference of $.0011 per lamp hour between these two kinds, shown above, amounts in a year to $4.40 per lamp on a street lamp burning 4,000 hours per year, or to $5.40 per lamp on an all-night commercial lamp. This difference is sufficient in some cases to determine whether the operat-

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ELIHU THOMSON.

Born in Manchester, England, in 1854. Now Chief Electrician General Electric Company. Inventor of Recording Watt Meter, Thomson-Houston System Arc Lighting, Generator and Lamps, Lightning Arrester and other appliances.

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The Electrical Journal.

Vol. 1. CHICAGO, JULY 15, 1895. No. 4

THE SINUSOIDAL CURRENT.

Its Derivation, Physiological and Therapeutic Action—Cases in Which It is Superior to Ordinary So-Called Faradayism.

BY J. ALLAN HORNSBY AND H. G. BROWNELL.

When a wire is moved through a magnetic field in such a manner as to cut across the lines of magnetic force, an electro-motive force, or electric pressure, is set up in the wire. The value of this electro-motive force is proportioned to the *rate* of cutting of the lines of force.

If we have a single loop or turn of wire revolving in a field, as shown in Fig. 1, the electro-motive force generated in the loop will vary according to its position. The direction of the lines of force of the field is from N. to S. When the loop is vertical as shown by the full lines a slight motion in either direction will cause the horizontal portions of the loop to move parallel to the lines of magnetic force and therefore no E. M. F. will be set up. When the loop is horizontal a slight motion will cause the parts parallel to the axis to cut lines of force at right angles. Between these two positions the lines will be cut more or less rapidly, if the motion is uniform, the rate being zero in the vertical position and maximum in the horizontal position, and gradually varying between the two. The E. M. F. set up, being proportional to the rate of cutting, will also vary from zero to maximum during this quarter of a revolution. During the next quarter while moving from a horizontal position to a vertical position the E. M. F. will, in a similar manner, decrease from maximum to zero because of the decreasing rate of cutting of the lines of force.

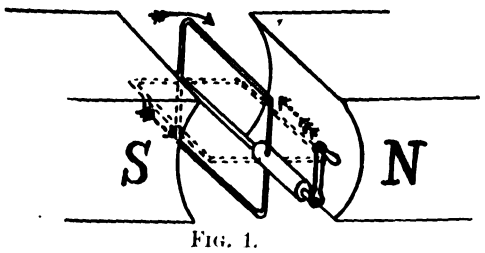

FIG. 1.

The *direction* of this induced E. M. F., depends upon the direction of the motion of the wire across the lines. When the loop of wire revolves, one side is moving downwards across the lines while the other is moving upwards. The E. M. F's. in these portions of the loop will therefore be in opposite directions as indicated by the arrows in Fig. 1.

When, therefore, the loop moves through the third quarter of its revolution the E. M. F. will rise from zero to maximum as in the first quarter but will cause current to flow in the opposite direction through the wire. In the fourth quarter the E. M. F. will again decrease to zero as in the second quarter, the direction of the current being the same as it was in the third quarter.

These results may be plotted in the form of a curve. If a straight horizontal line (O X in Fig. 2.) represent zero E. M. F., distances above will represent the values of E. M. F's. in one direction and distances below E. M. F's. in the opposite direction. Lengths along the line may be made to indicate the various positions of one side of the revolving loop. The distance A C represents one half of a revolution and C E the other half. The curve A B C shows the rise and fall of E. M. F. from zero to maximum and back to zero again. At C the direction of the E. M F. reverses, but the value again increases and decreases as during the first half revolution and as represented by the curve C D E.

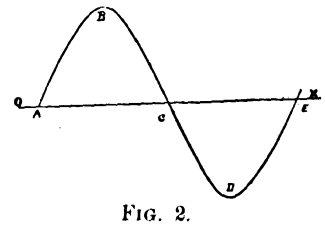

FIG. 2.

If this E. M. F. be applied to a constant resistance we know from Ohm's law $\left(C=\frac{E}{R}\right)$ that the resulting current values will vary in the same manner. In other words, the current produced would be alternating and of gradually varying strength.

The curve already described is known as a sinusoidal or sine curve and the current which is represented by it is therefore called a sinusoidal current.

A true sinusoidal curve follows a certain law, that is, its ordinates are proportionate to the sines of its abcissas.

A true sine curve could be produced by the following experiment: take a band of paper (A B Fig. 3), which should be made

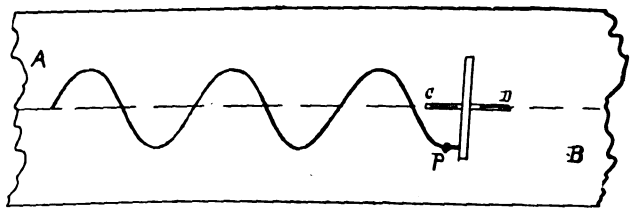

FIG. 3.

to travel in a horizontal line in one direction—say from right to left—and the vertically falling shadow of a pin or projection P fixed on a wheel rotating steadily in a vertical plane across the paper about the axis C D, then the trace that the shadow would photograph upon the paper would be sinusoidal, no matter what the speed of the paper or of the wheel.

It is not an easy matter to build a machine which will generate a true sinusoidal current, because of the difficulty experienced in producing a magnetic field which will remain uniform while an armature containing iron is revolved in it.

The magneto-electric machine, which was at one time much used by physicians, dentists and others for muscular excitation until it was supplanted by the medical induction coil, furnishes a current roughly sinusoidal in character.

Dr. J. H. Kellogg, of Battle Creek, Mich., has used for a number of years a common magneto generator, wound for about fifty volts at 3,000 revolutions as a source of sinusoidal currents. In

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1893, in a paper read before the American Electro-Therapeutic Association, he described his machine and also a device for determining the nature of the current derived. This latter was a modified D'Arsonval galvanometer, having a marker attached to the moving coil, which touched the blackened face of a revolving cylinder. This cylinder was revolved while the alternating current derived from the magneto generator moved the marker up and down at right angles to the motion of the surface of the cylinder. The resultant was a curve drawn on the surface of the cylinder, which, it was supposed, represented the current which was derived from the generator. One of the curves derived from Dr. Kellogg's magneto generator is illustrated in Fig. 4. It will be seen that this approximates a sine-curve, and, if it truly represented the current derived from the magneto, would indicate

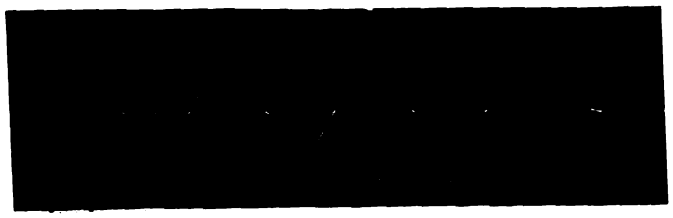

FIG. 4.

that the latter machine was an admirable sinusoidal current generator. It has been found, however, that the current from a magneto can, with this recording instrument, be made to draw almost any form of curve, from the smooth, sinuous one illustrated, to one which is quite serrated and somewhat irregular, simply by changing the adjustment of the parts and by varying the pressure of the marking point on the cylinder. The serrated curve probably more accurately represents the current than does the sinuous curve. An exact and simple method for mapping such curves is very much needed.

A magneto generator can be made to generate a current which is more nearly sinusoidal than is that obtained from the common machine by properly shaping the pole pieces and armature. The air space between the pole pieces and the armature should be very narrow at the center of the face of the pole piece and quite wide near the upper and lower edges. These edges, and also the edges of the armature faces, should be well rounded.

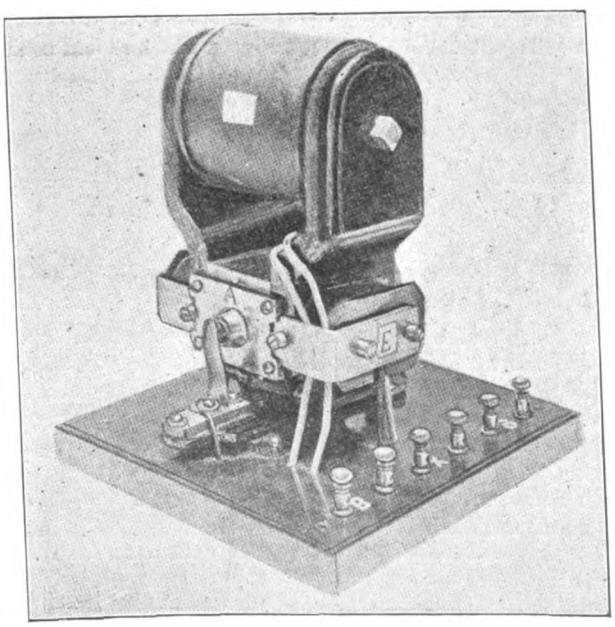

FIG. 5.

In his recent machine, Fig. 5, Dr. Kellogg has substituted a separately excited electro-magnet for the permanent magnets in order that the E. M. F. generated may be varied without varying the speed of the armature. In this machine the currents are generated in the manner indicated in the simple ideal dynamo illustrated above.

Mr. A. E. Kennelly, the well known electrical engineer, has designed a machine, which is illustrated in Fig. 6. In this machine the principle of electro-magnetic induction is applied in another way but the current produced is practically the same as that generated by Dr. Kellogg's

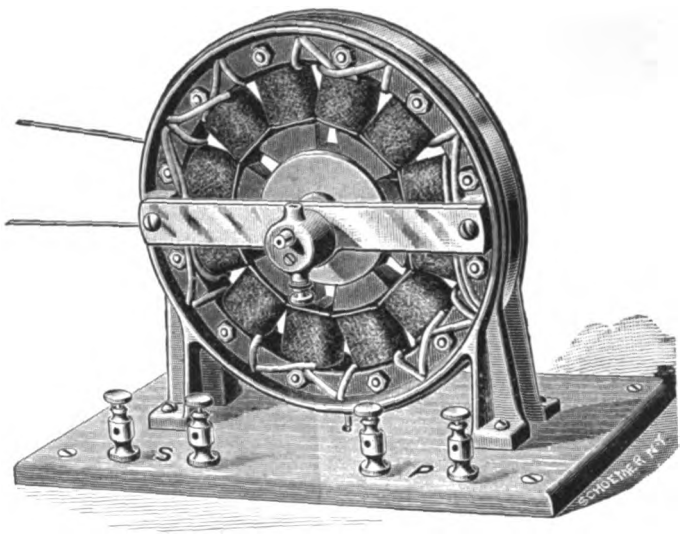

FIG. 6.

machine. The field frame is of laminated iron supported by castings, and has twelve poles; on each pole is a spool with two windings of wire. The inner has eight layers of fine wire, the outer two layers of coarse. All the fine wire coils are connected in one series and constitute the secondary or delivery coil. All the coarse wire windings are connected in another series, forming the primary or field windings of the machine. By this arrangement it is only necessary to drive the armature, which is composed of several layers of sheet iron, in order to transform a continuous primary current into alternating waves in the secondary circuit. The slots and projections on the armature are so proportioned that these waves are made practically sinusoidal. Twenty-four alternations or twelve complete periods occur at every revolution of the armature; speed of 80 revolutions per second can be attained and will therefore give 1,920 alternations per second or a frequency of 960.

The electro-motive force of the secondary circuit depends upon the strength of the inducing or primary current and this may be made to vary independent of the frequency by means of a rheostat in the latter circuit. The primary circuit may be derived from primary batteries or street mains and should have an available capacity of two amperes, although less than that amount is often used. In measuring the secondary current as delivered from the alternator the inventor found no difficulty in obtaining 25 ma. when the resistance did not limit the output.

The E.M.F. when the secondary is open, varies directly with the speed and with the strength of current in the field of primary circuit. With one ampere in the latter circuit, the limit of the E. M. F. in the open secondary circuit is about 50 volts, which means 70 volts, approximately, at the top of each wave, the 50 volts representing the average pressure. The moment the secondary circuit is closed, there is a fall of pressure in this circuit due to the impedance to the current delivered and also owing to the reactive influence of the secondary current. The voltage in this circuit in actual use therefore differs according to the resistance offered. When this is low the voltage is correspondingly low. The pressure of the derived current may vary therefore, according to these conditions, from 0 to 50 volts.

The currents derived from the secondary coil of an induction coil are also alternating but the variations are not regular and a greater electro-motive force is generated in one direction than in the other—that accompanying the opening of the primary

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circuit being greater than that produced at the closing of the circuit, as is shown in Fig. 7.

FIG. 7.

Several electricians are now at work endeavoring to produce a machine which will generate a current that will approach still more nearly the sinusoidal form.

PHYSIOLOGICAL ACTION.

The physiological action of the sinusoidal current may be almost completely described by the one word "Tonic." It is a stimulant of the motor and sensory nerves, of muscular tissue, of elimination, of assimilation. Being tonic in its effect, it is naturally also sedative in the same sense that digitalis is a heart sedative. Its tendency is to establish normal function, and the establishment of normal function carries with it the elimination of sources of irritation, whatever their nature may be.

If we except the use of very high frequency alternating currents, the sinusoidal current may be used with advantage wherever we have been accustomed to apply the faradic or ordinary alternating current. If we can reach a point in the frequency of alternations by the alternating current, as D'Arsonval claims, beyond the response of nerve tissue, and if D'Arsonval is correct in his assumption that these high frequencies are more desirable than any other form of current where we wish a physiological rather than a physical effect, then we must draw the line in these cases against the sinusoidal current, for the reason that up to the present time we are not able to reach high frequencies, and, indeed, if we were, the greatest advantage of the sinusoidal current, i. e., the regularity of contractions produced, would seem to have been lost.

The elimination of the shock to muscular and nerve tissue is the chief physical difference between the sinusoidal and the ordinary faradic current, and the chief advantage of the sinusoidal current lies in our ability to give larger doses of it without the distressing physical inconveniences which the other causes. We might put it another way. The sinusoidal current would seem to have the same advantage over the ordinary faradic that the even exercise of bicycle riding, for instance, would have over that sort of muscular development induced by prize fighting.

THERAPEUTIC APPLICATION.

From experiments made by several of the European investigators, also by a number of our own people, there seems to be no good ground upon which to deny the immediate passage of an electric current through tissues of the body, including the brain and spinal cord. If we accept this as fact, then we have a clear field upon which to base our therapeutic uses of the sinusoidal current.

We shall oftentimes have occasion to keep up muscular activity, local or general, where central function is temporarily destroyed as, for instance, following apoplexy. The sinusoidal current, in these cases, seems to have a special faculty for creating even and regular contractions of muscle, singular and in groups, without respect to its application at motor points.

Experimenters have demonstrated that a current passed between electrodes in the two hands of a patient will create rythmic and strong muscular contraction in all of the muscles of both extremities, shoulders and chest, and two sponge electrodes placed, one on either side of the abdomen, will give strong and even muscular contractions in all the muscles that go to make up the visceral support.

Some work has been done in the application of the sinusoidal current in cases of women whose sedentary habits and want of exercise have developed the pendulous abdomen, with the consequent distress due to a falling down of all the abdominal viscera. In these cases there seems to be a toning up of the abdominal muscles and a coincident toning up of function in the intestinal track, and, indeed, the whole internal organism seems to be improved so far as function is concerned.

One of the directions of application which seems to me not to have been dwelt upon at sufficient length is in cases of subinvolution and chronic enlargement of the uterus. There can hardly be a doubt that many of the distresses of womanhood are due to simple torpidity of the uterine muscular structure. If we can bring into active condition all these involuntary muscular fibres without the distresses attendant on the ordinary faradic current, very many of the so-called "female troubles" will be done away with.

Going to the organs of alimentation, especially the stomach, the sinusoidal current is especially efficacious, particularly in functional inactivity. If we can increase the gastric secretions, we can decrease a large percentage of the dyspepsias that depend upon the sedentary habits of our business and idle classes, and there is no doubt that the sinusoidal current has a wonderfully stimulating effect on the muscular fibres of the stomach, and in that respect will supply the place that we attempt to supply by enforced exercise—long walks, horseback and bicycle riding, etc. Dr. Kellogg, in his experiments, has found that following the use of the sinusoidal current in some of these cases, the tonicity of the stomach has been enhanced to the extent that it is raised in the abdominal cavity, in some cases, several inches.

While there is no doubt that the sinusoidal current has a special stimulating influence on that sympathetic nervous organization that plays so important a part in physiological function, yet not all of the benefits derived from the use of electricity can be ascribed to that particular effect, as the exercise due to contractions, rythmic, regular and restful, certainly plays a large part.

I have outlined a few pathological conditions that the sinusoidal current seems especially designed to correct, and its application, in cases that vary in their pathology from those I have cited, would hardly seem to call for further elaboration, as the physician will supply practice in special cases.

WILL SUPPLANT COAL AND BELLOWS.

An electrical forge, the device of George D. Burton of Boston, was exhibited recently at the power house of the Buffalo Railway Company. It can be operated, it is claimed, at an expense of 20 cents per day, and its use effects a material saving of time over the old coal forge besides turning out better work. The same inventor has another device for tinshops and still another—a jeweler's forge—for welding gold and silver. The blacksmith's forge consists of a receptacle for holding water, which in this instance was square, though in other cases half barrels are used. This receptacle or box is filled three quarters full of water, carbonate of soda and borax. To the plate at the bottom of the tub the positive pole of a battery or electric line is connected, while the negative pole is joined to the rest. A current from the dynamos at the power house was used here. By resting the handles of the tongs or the bar of metal used over the rest and lowering the object to be heated until it touched the surface of the water, the electric circuit was completed. Instantly the iron began to glow and in less than 30 seconds was at a white heat. The hammer and anvil did the rest.

IN A NUT SHELL.

An exchange, in commenting on the substitution of electricity for horse cars and the probability of horseless carriages coming into use, says:

"The miserable hacks in London cabs, the street car horses of New York and elsewhere and the overworked animals in the carts of poor teamsters are better off as an extinct race. The horse will be improved for some purposes; transportation will be cheaper and better, and the streets will be cleaner."

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RECENT UNDERWRITERS' RULING.

Trolley Wire Currents for Light and Motor Purposes Condemned as Dangerous—Voltage Classed as "High Potential" Under the Rules.

BOARD'S ACTION ENDORSED BY EXPERTS.

The practice of using current from trolley wires in the operation of lights and motors in buildings is one which, it is contended, creates so great a fire hazard that the National Board of Fire Underwriters has taken the matter in hand with a view to putting a stop to it. That some action in this connection was called for is shown by quite a number of fires which are reported by the Electrical Bureau of the Underwriters Association, and in taking the stand they have, they are supported by electrical engineers and experts all over the country. The rule that has been framed to meet the exigencies of the case while brief, is very much to the point. It reads—*Lighting and Power from Railway Wires, must not be permitted under any pretense, in the same circuit with trolley wires with a ground return.*

The opinions expressed by those who are best competent to judge would seem to establish the fact that the practice is a poor one from every standpoint except the single one of convenience. Following are some of the letters which have been sent to the Underwriters' Electrical Bureau in response to a request for an expression on the subject.

Prof. Wm. A. Anthony, of 919 Temple Court, New York, writes:

UNDERWRITERS' ELECTRICAL BUREAU:

"I am fully in accord with the view upon which the rules of the fire underwriters are based, namely, that a ground return increases the danger to be apprehended from electric wires, and, therefore, that the wires from railway circuits and others employing a ground return should not be allowed inside of buildings for the distribution of light or power. I do not know that there is much more to be said about it. The added danger due to a ground return is obvious and undesirable. Only a very substantial compensating advantage could warrant the incurring of such an added risk. I do not know of any great advantage to be gained. If the demand for lighting or power is sufficient to be worth considering, it is sufficient to warrant a separate machine and circuits. Power service from trolley circuits is usually far from satisfactory any way in consequence of variations of pressure, and there is, therefore, the less to be urged in its favor."

J. P. Barrett, Superintendent of the Chicago Fire Alarm and Police Telegraph Service, says:

Underwriters' Electrical Bureau—

I will state briefly that I am opposed to the present arrangement of trolley wires in large cities on general principles. The method of connecting one side of the generators to the earth maintains a constant high difference of potential between the conductors and the earth, tending to force a heavy current through intervening substances, and there is consequently great danger from them to life and property.

I believe the introduction of such wires into buildings for the purpose of operating lights or motors should be prohibited. I believe every person, firm or corporation operating electrical apparatus for the purpose of furnishing light and power in buildings should be obliged to maintain highly insulated metallic circuits. With such circuits there is practically no difference of potential between conductors and earth, and the danger to life and property is is reduced to a minimum.

E. P. Roberts, of Cleveland, thus expresses his views:

Underwriters' Electrical Bureau—

We believe it to be bad engineering, which includes the matter of fire hazards, to operate lights or motors from street railway circuits. It is not allowable in Cleveland, and we do not consider it advisable in any case, although we might consider it allowable where the wiring is all open work, and fuses or automatic switches are properly proportioned, and wires always under expert supervision, and, in fact, the whole installation put in with special regard to safety; but for general commercial use we would object to operating translating devices in buildings from street railway circuits.

Field & Hinchman, electrical and mechanical engineers of Detroit, briefly express themselves as follows:

Underwriters' Electrical Bureau—

In reference to your inquiry as to the advisability of the practice of operating motors in buildings when supplied by current from trolley wires having grounded return, we beg to say that in our opinion the practice is in general not to be approved. As regards danger to life and fire risks its use is attended with considerable hazard. For lighting purposes the service is not satisfactory for general use.

Summarizing the experience of the fire underwriters, and the views as expressed above, William H. Merrill, Jr, the electrician of the Chicago Board, thus presents the matter:

The principal reasons why this system of electrical distribution is far inferior and more hazardous than systems ordinarily used are as follows:

One side of the circuit is normally grounded—that is, the current depends upon the earth or pipes or wires in the earth for part of its path. This means that but *one* accidental electrical connection between any part of the wiring of the system and a gas or water pipe or structural iron work or conducting substance of any nature in electrical connection with the earth is necessary, in order to establish current flow and a resulting "burn out" or fire. In a complete metallic circuit *two* such connections are necessary, one on each side of the circuit, before current flow can be established, and, therefore, the grounded system is considerably more than twice as hazardous as the metallic.

The wires of a trolley road being run overhead are susceptible to lightning discharges; and a line being run into a building to a motor and then into the earth, affords an easy, convenient, and oftentimes preferable path for the discharge to travel, setting fire to the property on the way.

The voltage or "pressure" used on trolley systems is sufficiently high (500 volts) to be classed as a "high potential" under the rules, and the energy used on the circuit is sufficient to necessitate the generation of large current quantities, oftentimes great enough to produce very severe heating effects. We have then the disadvantages of the series arc system in the comparatively high voltage used, which tends to break down our insulation, coupled with the disadvantage of the low potential system, which uses large currents, and this results in bringing about enormous heating effects at the point where the break occurs. This high voltage and large current is a very bad combination to properly control under the most favorable circumstances. When traveling over the uncertain path offered by a grounded trolley system, it cannot be considered desirable or safe for introduction inside of buildings.

No arguments for "protection" of the circuits by all the proposed remedies for the evil thus far invented can hold as long as the ground connection remains. A cross between a gas pipe, for instance, and the wire running from the motor to the ground cannot blow the fuse, since the resistance of the motor intervenes and arcing may therefore be indefinitely maintained at the point of contact. Lightning arresters, extra insulated wire run on large size glass insulators, special fuses, double mounting of the motor, grounding outside the building, a sign reading "danger," a voltage reducer and numberless other proposed safeguards, are advantageous, and each does its little to decrease the probability of trouble, but they cannot make a grounded circuit the equivalent of a metallic circuit from any point of view.

The fluctuations of voltage on trolley circuits and consequent sudden increase of current flow makes proper fusing of the circuit improbable.

Having proven by costly experience and by the testimony of qualified judges that it is bad practice to operate motors in buildings from trolley wires, and having given a summary of the principal reasons for the objections, it would be well to consider how people who have made the mistake of installing such outfits can be aided. The following courses are suggested:

1. If there is a 500-volt metallic circuit in the vicinity, have the apparatus transferred to connect with it in place of the trolley.

NOTE: By a metallic circuit is meant one which is not in electrical connection with the ground at any point on the line, or at the dynamo, or switchboard, or anywhere else. It is one in which the path for the current throughout is established through well-insulated copper wire.

2. If there is any metallic circuit other than a 500-volt circuit near enough to obtain a connection from, sell the 500-volt motor and buy one proper for introduction on the metallic circuit.

3. If there is no metallic circuit within reach and there is enough demand for stationary power to warrant an investment in a metallic circuit, try and influence the trolley company, or some one having surplus steam or water power, to install and operate such a circuit entirely independent of the trolley system.

4. If none of the foregoing are possible, and it is not feasible to supplant the electric equipment with some other power machinery, have the entire installation, including motor, resistance box, switch, cut outs, wire and electrical arrangements of all kinds moved *outside* of the building and installed in a separate fire-proof structure, entirely cut off from the main building. Power can be communicated from the separate structure to the main building by means of a shaft inclosed in an iron pipe, sealed at the ends. The motor can be started, stopped or regulated from inside the main building by any convenient *mechanical* means which does not bring about a possibility of communicating fire from one structure to the other. The separate structure should be built of brick, with a non-combustible roof. Not necessarily being larger than simply sufficient to include the motor and its controlling apparatus, this structure can be built at a comparatively small cost, and together with cost for foundations for the motor, would well repay the investment in the increased safety secured in having all power machinery located outside of one's premises. Special attention must be paid to the construction of the structure containing the motor to insure its successfully preventing fire starting in it from communicating with the main building.

5. Lamps operated by current supplied from trolley wires are undesirable from every point of view. In the general run of cases they will be or should be replaced by some other illuminant. There have been a few special cases where, owing to the urgency of circumstances, the following construction has been employed. This arrangement overcomes the objectionable

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features of operating lights direct from the trolley wire by installing in a separate building, removed from and making no exposure to insured property, both a motor and a dynamo. The motor is operated by current supplied from the trolley wires, and serves to drive, *by a belt*, the dynamo which supplies through a metallic circuit current at 110 volts to lamps in the insured property. In this way the circuit in the building is not grounded, its voltage is reduced, and its source of supply is limited. The additional cost of such an arrangement is represented by the price of the motor, of the dynamo, and the work of installation, together with the necessary detached building.

The operation of lamps direct from trolley wires is more objectionable than the operation of motors. Both practices are hazardous and are strongly to be discouraged.

THE ELECTRICAL ENGINEERS AT NIAGARA FALLS.

The large attendance at the recent meeting of the Electrical Engineers was doubtless due to the combined attractions of the water fall and the water power at Niagara. The latter has acquired a celebrity scarcely inferior to the former, especially among engineers and that goodly body of intelligent men who are watching with great interest the progress made in utilizing the energies which nature has generously placed at our command.

It is too much to expect even enthusiasts to devote the entire day in a hot summer month to the discussion of technical papers, be they ever so interesting. It was therefore a wise provision on the part of the managers to leave each afternoon to sight-seeing and to the calm contemplation of the stupendous cataract.

When one has acquired a fair apprehension of the unit of power in the power house of the Cataract Construction Company, and especially in the roaring cavern at the bottom of the wheel-pit, he is prepared to make an intelligent estimate of the power running to waste over the brink of the falls. We were afforded the opportunity to get an idea of 5000 horse power in bulk, and this is the unit of power at Niagara.

Through the courtesy of the Cataract Construction Company the first afternoon of the session of the Institute was devoted to seeing the works and the big dynamo in operation. It added not a little to the interest of the occasion to have present the men who designed and made it. Mr. Stillwell and Mr. Scott were both extremely kind in explaining various interesting phases of the installation. It is now pretty well-known that the field-magnet of this great two-phase generator is a huge ring supported by an immense "driver," shaped like an umbrella or toadstool, fastened to the top of the wheel-shaft as a stem, and that it revolves outside of a stationary armature. This great ring, on the inside of which the field poles are bolted, is 11 feet 7½ inches in diameter. It was forged from a single ingot of nickel steel. A ten-inch hole was first drilled through the ingot and this served for the introduction of a mandrel on which the ingot was expanded by a 14,000 ton hydraulic press. Its normal speed is 250 revolutions per minute, giving a corresponding peripheral speed of 9100 feet. But its tensile strength is capable of withstanding four or five times the strain thus put upon it. Besides, the magnetic pull is inward, thus offsetting in part the centrifugal force. The total weight of the revolving member of this dynamo, which must be supported by the shaft, is no less than 79,000 pounds. It thus furnishes the necessary fly-wheel effect, which is estimated in terms of pounds multiplied by feet per second squared as 1,274,000,000. The conditions imposed by the contract required that the weight of the revolving element should not exceed 80,000 pounds, and the fly-wheel effect should not be less than 1,100,000,000, measured as above.

So effective is the governor controlling the wheel and so great the regulating power of the field-ring as a fly-wheel that the sudden throwing off of a load of 1,500 horse power quickened the speed by only five or six revolutions a minute. It is not likely that a more abrupt checking of the flow of water would be allowable with due regard to the safety of the penstock. At a speed of 800 revolutions a minute, or at a peripheral speed of nearly six miles a minute, the ring would burst. But with the safety appliances adopted it is quite impossible for the generator ever to acquire such a speed.

The armature is separated from the pole pieces by the unusual air-space of an inch. It is built up of mild steel punchings 0.015 in. thick and is divided into six horizontal sections, separated from one another by inch spaces for ventilation. With copper and iron losses of 2.5 per cent., the energy that must be disposed of as heat amounts to 125 horse power at full load. To insure ventilation, the "driver," supporting the revolving ring and connecting it with the shaft, is pierced with large openings which are provided with hoods pointing backwards as the wheel rotates. These hoods aid the natural upward draft produced by the heating of the interior and insure a rapid current of air.

The generator is self-exciting to this extent – it drives a rotary transformer, and the direct current from it is carried around the bobbins of the field. The energy required to excite the field has been determined to be fifteen horse power; the loss in the armature core is estimated to be sixty horse power; the loss in the conductors of the armature, thirty horse power. To these losses must be added the mechanical losses in friction and windage, amounting to fifty horse power more, making a total loss of 155 horse power under full load. This would indicate an efficiency of 97 per cent. It is an extremely difficult matter to determine with exactness the efficiency of such a dynamo. The difficulties are apparent to any one who has ever attempted to measure the efficiency of a machine approximating 1,000 horse power. The stray power method affords the most convenient one whenever it can be applied.

During the meeting of the Electrical Engineers the great dynamo was loaded to 5,300 horse power of electrical energy at its terminals, with a possible 500 or 600 horse power in reserve in case of necessity. This magnificent machine should determine the question of the practicability and economy of long distance transmission of power on a large scale. About sixty years ago Joseph Henry transmitted the first mechanical power to a considerable distance in the city of Albany; again New York is the field of operations, and all eyes are turned in that direction to see what success attends the trial. There is some difference of opinion among electrical engineers as to the outcome, but the more hopeful element sees victory in the near future.

Henry S. Carhart

LET WELL ENOUGH ALONE.

Under the above caption the *San Francisco Reporter* in an editorial expresses its views on electrocution as follows:

The question of whether electricity, as at present applied to the execution of murderers, kills instantly and painlessly, is being revived in connection with the execution of Dr. Buchanan, which event recently took place. Many doctors contend that the application of the volts is torture, and that the victim is not dead when he is taken from the chair.

It seems to us, however, that the imitation of death is so good that it might be allowed to pass. We believe it is a fact that no murderer who ever sat in the electric chair has pursued his career of crime any further or given the police or society any more trouble, and surely that ought to be enough.

Somehow or other the theory that death by electricity may inflict a certain amount of pain upon a murderer has never excited our alarm or pity to any great extent. We never could see exactly why the trip across the river should be made as smooth and pleasant as possible for murderers. Few of them show any very tender consideration for their victim.

We are in favor of putting murderers out of the way of further mischief in the speediest and cleanest method possible, and if the process happens to be one with some terrible uncertainties about it for the murderer—so much the better. The surviving criminals will be all the more impressed. As long as there are no uncertainties about it, so far as the law-abiding public is concerned, we do not see why any fuss should be made about it.

HOW OREGON DISPOSES OF SURPLUS HORSES.

As for the horse, he is to pass into poetry, paleontology, and, alack, the boneyard—*Chicago Times-Herald.*

No, sir; we can 'em in Portland. All orders from the East promptly attended to.—*Portland Sun.*

The only part of the horse not utilized by the packers of Portland is the neigh, and they expect to be able to make use of that in some way very soon.

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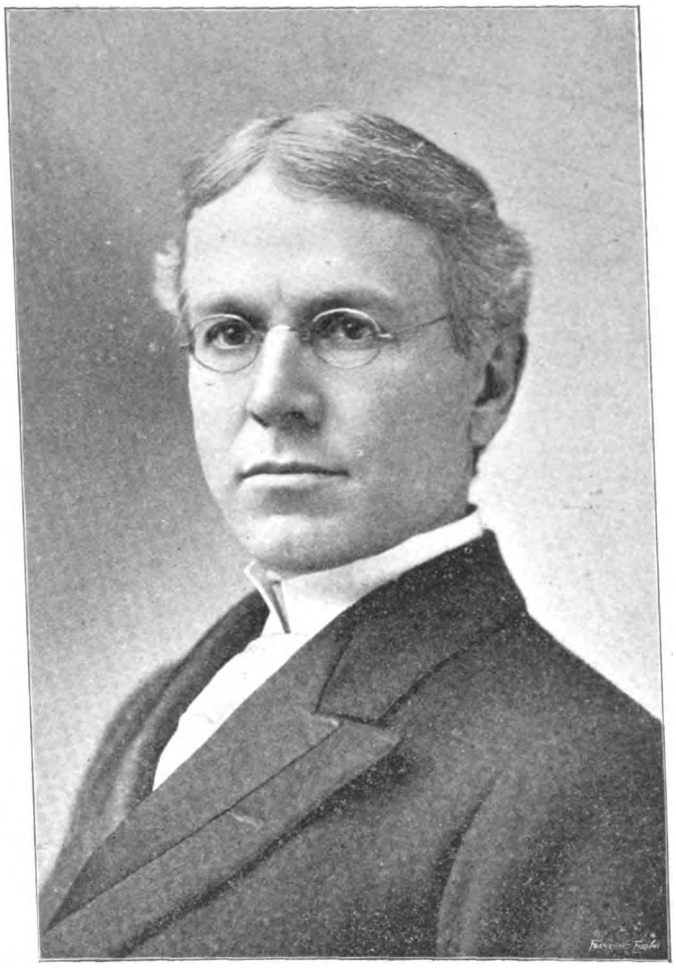
PRIZES FOR MOTOR CARRIAGES.

Chicago Times-Herald Offers $5,000 to Stimulate Inventive Genius—Test to Take Place in November—Race to Be from Milwaukee to Chicago.

COMPETITION WILL BE OPEN TO THE WORLD.

The Chicago Times-Herald offers the sum of five thousand dollars as prizes for the successful competitors in a horseless carriage or vehicle motor contest. The first prize is for $2,000 and a gold medal—open to the world. The second prize is $1,500



H. H. KOHLSAAT,
Proprietor of the Chicago Times-Herald.

with a stipulation that in the event the first prize is awarded to a vehicle of foreign invention or manufacture, this prize shall go to the most successful American competitor. The third prize is $1,000 and the fourth $500.

This offer is made, the Times-Herald says, with no idea or intention of starting a horseless carriage fad, or of promoting a craze in this direction. It is the deliberate opinion of the best mechanical experts in the country that the inventive genius of the world is in a fair way to solve the problem, if it be not already solved. It is also a fact, which cannot be denied or overlooked, that the United States is in the rear of the procession in this branch of inventive progress, while it should be in the front rank. This is a country of magnificent distances and its resources can never be utilized to the greatest advantage until the mechanical genius of the country has brought the science of transportation to its highest possible development.

The now inevitable progress along this line will force to the front the question of good roads. When to the unanimous demand of the army of wheelmen is added the influence of the coming devotees of the swift-running vehicle motor, the good-road movement will have achieved its mission, and there will extend over the entire country a network of broad, smooth highways. It is not possible to overestimate the influence upon the nation of a revolution of this character, and even in the closing years of the century this problem is destined to be an all-important one.

The horseless carriage is the sensation of the hour in France and Germany, and already has commanded the favorable attention of the English parliament. The best inventive genius of the old country is at work on the problem, and, although the science has hardly passed the experimental stage, results of far-reaching significance have been attained. At the Columbian exhibition there was but a single example of this class of vehicle. It attracted some attention and a little comment, but few saw in the heavy and rather clumsy carriage the possible germ of a coming change in methods of transportation, by which the horse was to be yet further despoiled of his usefulness.

A few weeks ago saw another exhibition. In a race between Paris and Bordeaux, over one hundred such vehicles were entered and the successful competitor made the round trip of 750 miles between the two cities at an average speed of nearly sixteen miles an hour. When it is taken into consideration that the route included long stretches of bad road, with hills and steep grades, this performance is in every way a remarkable one. It sets a pace far too fast for a horse, and at a single bound raises the common country road into the position of a formidable competitor with the railroad and the locomotive.

The eighty-five miles between Chicago and Milwaukee, the route of the proposed race, probably affords as fine a roadway for such a test as can be found in this country. There are no hills of too steep a grade and in ordinary weather the entire distance is favored with roads which are the delight of bicycle riders. The Times-Herald makes the offer of $5,000 in time to permit the construction and perfection of a carriage as yet but dimly outlined in the brains of American inventors. A horseless carriage is not an expensive creation and it may be accepted as certain that the successful type of the future will be light of construction, few and simple in its parts, with the item of durability ever kept foremost.

In view of the fact that the foreign inventor has thus far taken the lead in this direction, it has been deemed only fair that the stipulation be made that either the first or second prize shall be awarded to some American competitor. Four months is a long time when reckoned in the chronology of American inventive genius, and the Times-Herald will be surprised and some disappointed if an American inventor—one from Chicago preferred—does not glide past the Grant monument that November afternoon, the first in the race and amid the acclaim of 100,000 spectators.

The few thousand dollars representing the money prize do not even faintly represent the financial awards which will accrue to the successful owners of these carriages. Those who have followed the development of the bicycle and who have seen successful manufacturers of the silent steed reap fortunes in the past few years can realize the harvest which awaits the inventor who gives to the world a practical and perfect horseless carriage. Even if the money consideration be eliminated, there yet remains honor and glory for the man or men who first guide their carriage down the eighty-five miles which separate the Cream City from the Garden City.

In the near future there will be announced the exact rules of the contest, the officers and judges of the same and such other information as may result in a perfect understanding of all the conditions.

"Fortune has rarely condescended to be the companion of genius," Disraeli once remarked, but the man who invents a practical horseless carriage will be an exception to the general rule.

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TEST FOR INSULATION RESISTANCE.

The "Voltmeter Method"—Simple, Rapid and Accurate, Requiring no Apparatus but a Voltmeter.

A method of testing the insulation resistance of cable conductors, as well as pole lines, that is coming more and more into extended use by the various telephone, telegraph and electric light companies, having lines to maintain in good condition, is described below. By means of a single voltmeter properly standardized, tests can be made on a series of cable conductors or pole lines in rapid succession.

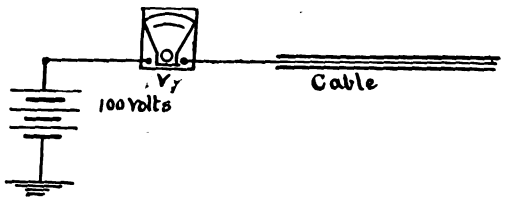

FIG 1.

Let Fig. 1 represent the connection for testing the insulation resistance of a cable conductor. The voltmeter is connected in circuit between a source of constant E. M. F., and the conductor whose insulation resistance from ground it is desired to determine. The source of E. M. F. may be a "testing battery" of silver chloride cells, a storage battery, or the constant potential mains of a direct current incandescent lighting system. The last is frequently more convenient for use in this test, as in many places the neutral or middle wire of the usual 3-wire incandescent system is already grounded, so that it is only necessary to connect one of the "outside" mains of the system to the voltmeter circuit, as more clearly shown in Fig. 2.

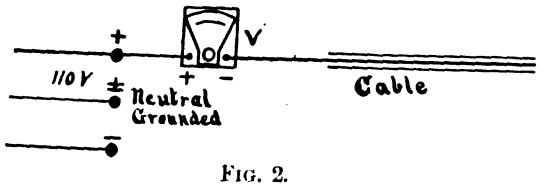

FIG. 2.

In the circuit shown in Fig. 2. an E. M. F. of about 110 volts is available to obtain a readable deflection on the voltmeter by a leakage current through the insulation of the cable. In general, for commercial tests of moderate insulation, 110 volts will answer the purpose, as by its use in connection with a voltmeter reading from 0 to 150 volts—a commonly used range—insulation resistance as high as ten megohms can be measured with an accuracy quite good enough for most commercial tests. Of course, if it is desired to measure still higher resistances, it is only necessary to use a higher E. M. F. than 110 volts, such as may be obtained nowadays by connecting to the source of current supply for the almost universal trolley car—thus vastly extending the range of the method about to be described, and enabling one to do in many cases, better and quicker work by the aid of a good voltmeter alone than could be done with the most elaborate reflecting galvanometer, with accurate resistances, shunts, etc. Indeed, the strong points of the voltmeter method are, simplicity and rapidity of operation, combined with a very considerable degree of accuracy.

Referring to Fig. 1 as the simpler of the two, suppose we have at hand a Weston voltmeter with a scale reading from 0 to 150 volts and having a resistance, as marked on the cover of the carrying case, of 15,963 ohms For the purpose of this test, the resistance of the voltmeter may be called 16,000 ohms. The source of the E. M. F, used is a battery of silver chloride cells, giving a total difference of potential on open circuit of 100 volts. One pole of this battery is connected to one end of the conductor whose insulation resistance it is desired to measure, the other end of this conductor being carefully insulated where it comes out at the other end of the cable. The "ground" on the other pole of the battery may be an actual ground in the case of a cable which is already laid; or, if the cable is still on the reel, this pole of the battery should be connected directly to the lead sheath of the cable—or to its armor wires, if the cable is of the submarine type.

It will be seen that we have now a circuit from one pole of the battery through the voltmeter and into the cable conductor, thence by leakage through the insulation of the cable to the sheath or ground, and so back to the other pole of the battery. The feeble current which will flow through this high resistance circuit will give a certain deflection on the voltmeter. Call this reading v, which is at the same time the actual fall of potential through the voltmeter resistance.

We know from Ohm's Law, $C = \frac{E}{R}$, that when an unvarying current is flowing in a circuit, the E. M. F. falls off in proportion to resistance passed over, or in other words, the difference of pressure between any two points in a circuit is proportional to the resistance of the conductor between those points. In this case, then, the E. M. F. shown by the voltmeter and that taken up by the insulation resistance would be in the same ratio as the resistance of the voltmeter and the insulation resistance.

If the E. M. F. of the battery used be 100 volts, the E. M. F. taken up by the insulation resistance will be $100-v$ volts, and the proportion may be expressed as follows:

$$v : 100-v :: 16{,}000 : \text{Ins. Res.}$$

Solving this by the well-known "rule of three," we have:

$$\text{Ins. Res.} = 16.000 \times \frac{100-v}{v} \quad - - - \quad (1)$$

Suppose v. the reading of the voltmeter when connected up as shown, to the cable and battery, to be 2.5 volts; then

$$\text{Ins. Res.} = 16{,}000 \times \frac{100-2\,5}{2.5} = \frac{1{,}560.000}{2.5}$$

$$= 624{,}000 \text{ ohms} \qquad = .624 \text{ megohms.}$$

since a megohm is equal to one million ohms.

In order to make this formula general, let V represent the pressure of the battery, or whatever source of current is used; v the voltmeter reading, as before; r the voltmeter resistance and R the insulation resistance. Substituting these in (1) we have

$$R = r \times \frac{V-v}{v} \quad - - \quad (2),$$

thus giving an "expression" which can be used at any time for similar tests, putting in the place of v the reading obtained on the voltmeter, in the place of V the total E. M. F. of the battery or circuit used, and for r the marked resistance of the voltmeter.

When the E. M. F. used is at all subject to fluctuations, it is necessary to read the total E. M. F. of the battery or dynamo immediately before observing the deflection obtained through the cable. A diagram showing a convenient circuit for doing this, and at the same time illustrating the use of the trolley wire or feeder as source of E. M. F., is given in Fig. 3.

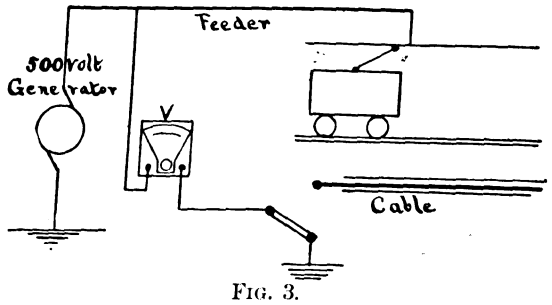

FIG. 3.

The voltmeter, having a range suitable for use on a 500 volt circuit, is connected to the feeder and a 2-point switch in the manner shown, so that with the switch at the left a reading may be obtained of the full E. M. F. This reading is noted as the total E. M. F. acting through the test circuit, and the switch is then immediately thrown over to the right-hand point, to obtain a reading given by the leakage current. Substituting these readings for V and v, respectively, in (2), will give the result in ohms.

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DEATH FROM ELECTRIC SHOCK.

Actual Cause is Found to Be Contraction of Arterial Muscles and Consequent Central Engorgement with Cerebral Apoplexy.

PAPER BY DR. A. H. BLEILE, OF COLUMBUS, OHIO

The work here given was undertaken with a view to elucidating the effects of large quantities of electricity on the organism. Incidentally the value of artificial respiration after death by electricity was also tested. As this is the minor portion of the work this part will be given first.

The data bearing on the subject in general are quite meager, especially as to the amount of current which actually passed through in fatal cases.

In all my experiments dogs were used, and in the subjoined table the weight, voltage, amperage and time are given for each case.

In the first experiment 525 volts, 2 amperes were applied for 8 seconds; in the second, 220 volts, 1.2 amperes; in the third, 106 volts, .4 ampere, 10 seconds; in the fifth, 96 volts, .35 ampere; 2 seconds; in the sixth, 52 volts, .3 ampere for 1, 2 and 4 seconds; in the seventh, 70 volts, .32 ampere, ½, 1 and 2 seconds was used.

Before the application of the current a canula was put into the trachea so arranged that it could at once be connected with a bellows for the purpose of giving very complete artificial respiration. Respiration was set up as soon as the current was off and this was continued for periods varying from 20 minutes in the first case to 2½ hours in the last, and in no instance was resuscitation accomplished.

Further work was carried on for the sole object of studying the effect of the current.

Our electrodes consisted of oval copper plates 3 by 2 inches, covered with sponges moistened with salt water. One electrode was applied at the base of the skull, and the other over the middle of the back, the hair of the animal having been previously well moistened with the salt solution. The current used was the alternating current of 130 periods per second. While the details of each experiment are given in the table subjoined, a few are selected for special presentation. The larger voltages were abandoned for 100 volts, 70 and 50, as near as could be reached.

Ninety-eight volts with .32 ampere was applied first ½ second, then 1 second with recovery, but in two seconds produced death. Fifty-two volts with .3 ampere was applied 1 second, later 2 seconds, with recovery, then 4 seconds, producing death. Fifty-two volts, .24 ampere applied 3 seconds produced death. Fifty-one volts, .12 ampere, 4 seconds, and 51 volts, .18 ampere, 4 seconds were not fatal. Fifty-one volts, .2 ampere, 4 seconds produced death. From these figures and similar ones to be obtained from the table, it is evident that the result depends, somewhat independently of the weight of the animal, on three factors: on the voltage, on the amperage, and upon the time of the application. A variation of either one of these factors may change the result—that is, a lower voltage with lesser amperage applied for a longer time will have the same effect as a current of higher voltage or more amperage applied for a shorter time. In this connection it was suggested by Professor Thomas that the joules necessary would be found the same in each case, and calculations show that this is approximately true. To prove this absolutely it would, of course, be necessary to work with the minimum quantities as to voltage, amperage and time in each case, and no doubt one or another of these factors will be found in excess in most cases. In these experiments it is of great interest to point out this approximate relation between the results and the absolute amount of mechanical energy used. The results found on post mortem examination of the animals were so uniform that they can be very briefly described. In all cases this examination was made immediately after death, and at first we wished to study the changes produced upon the heart, so that the incision was made through the chest walls and the heart exposed as rapidly as possible. This organ presented the following peculiar conditions: the left side was completely relaxed, the right side was intensly gorged with blood, as were also the large veins in the immediate vicinity of the heart, and the little appendages of the upper portion of the heart were found beating regularly, strongly and synchronously. Pressure on the heart caused a contraction of the other parts, and from this it was evident the death was not due primarily to the destruction of the heart fibers. In addition it was noted that the deep and extensive cuts made in the tissues were free from blood, and that the arteries were quite small and contracted.

This excluded a direct effect upon the heart, and, having shown by artificial respiration that the stoppage of this function was not the cause of death, other causes were to be looked for.

It was supposed that the current immediately struck the pneumogastric nerve stimulating those fibers which control the heart in that they have the power of arresting its beat, when strongly stimulated. To test this view, resort was had to the hypodermic injection of atropine, the action of which drug is to paralyze the nerve fibers, and thus prevent their action on the heart when stimulated. In one case $1\frac{1}{30}$ grain of atropine was given, 52 volts with .25 ampere was applied first for 2 seconds, then for 4 seconds, and this resulted in death. In a second case $\frac{1}{60}$ grain of atropine was given, 52 volts with .29 ampere was applied first 2 seconds, then 4 seconds, again resulting in death. These animals were not therefore rendered more resistant by the drug, and the theory as to the role of the pneumogastric nerve was abandoned.

I now recall the fact already mentioned that after death, incisions into the animal are not followed by bleeding, that the arteries are contracted down to a very small caliber, and that the blood is crowded into the very large veins in the trunk. Taking these facts, it was suggested that the current acted upon the arteries through the nervous center which controls their diameter. It is well known that the arteries are supplied with a middle muscular coat in which the fibers are circular, and their contraction would of course cause a narrowing of the artery, rise of the blood pressure, and a consequent impediment of the heart's action; in fact, it has been experimentally demonstrated that the arteries can be constricted to such an extent as to produce a rise of blood pressure which the heart is unable to overcome and that the circulation will stop from this cause. It is further known that we have in the brain most of the nerve matter whose function it is to control the vaso-motor nerves, the arteries at one time, and in one place contracting and thus decreasing the amount of blood at another time and in another place, dilating and thus increasing the amount of blood getting to another particular part. To test this view, that the action of the vascular nervous system was the cause of death, we resorted to the hypordemic use of nitroglycerine. It is known of this drug that it powerfully affects the arterial system, causing, when given in larger doses, an extreme dilatation of the arteries, and a consequent great lowering of the blood pressure.

The first animal received $\frac{1}{25}$ of a grain of nitroglycerine and, when the effects were fully established, a current, which was known to be fatal, was thrown in; namely, 50 volts, .24 ampere for 4 seconds, but the effects produced by this current soon passed off and there was complete recovery. Then 97 volts, with .54 ampere was thrown in for 1 second, but this caused death. In another case $\frac{2}{25}$ of a grain of nitroglycerine was used; here 25 volts, .22 ampere, a fatal dose, were thrown in for 4 seconds with recovery. One hundred and four volts, .6 ampere were thrown in for 4 seconds, producing death, but after the current was taken off there was noted eight deep although irregular respirations. In other cases where the nitroglycerine was used, there was no apparent effect, but some investigation led me to attribute this to the unreliability of the tablets of nitroglycerine used, and this drug was thus abandoned for

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nitrite of amyl, a substance which has the same physiological effects as nitroglycerine but which can always be obtained pure, and the effects of which can be more accurately regulated because it is given by inhalation. In the first case the animal was brought moderately under the influence of the nitrite of amyl, 52 volts with .24 ampere were thrown in for 3 seconds, (this, by the way, being a fatal dose ordinarily,) without producing death. Fifty-two volts, .25 ampere for 4 seconds, also a fatal dose, failed to produce death. Fifty-two volts, .3 ampere for 6 seconds produced death, but after the current was taken off the animal made 22 deep, regular respirations, though not a trace of the heart beat could be made out, this incidentally proving that stoppage of the respiration is not the primary cause of death.

Three more experiments may be selected. Nos. 24, 26 and 27 of the table.

No. 24 was a pointer dog in excellent condition, weighing 34 pounds. Nitrite of amyl was given until the effects were fully marked. Fifty and five tenths volts with .2 ampere were given for 3 seconds; after a pause the same quantity was given for 6 seconds, followed by a recovery. Three days later the same dog, who showed no effects at all of the previous treatment, was given—without the nitrite of amyl—51 volts, .2 ampere, 4 seconds, producing death.

In the last case a dog weighing only 12 pounds and of such general condition of weakness that the assistant protested against his use as not being competent to demonstrate anything, was given a full dose of nitrite, then 50 volts with .6 ampere were applied for 4 seconds and followed by recovery. The dose applied for 6 seconds produced death, and here again several respirations were noted.

The statements made in regard to the cause of death by electricity are so at variance with one another that it is unnecessary to review them here. Among other plausible reasons it has been stated that the current has a direct disintegrating effect on the brain and nerve tissues, and that herein is to be found the cause of the fatality The disintegrating effects of the current on the brain and nerve tissue said to follow are not to be seen microscopically, and the microscopic examination of these organs so far as made by us failed to reveal any change in their structure, It would appear, therefore, that death in electric shock is entirely due to the fact that the current produces a contraction of the arteries through an influence on the nervous system, and that this constriction of the arteries throws in such a mechanical impediment to the flow of the blood as the heart is unable to overcome, and that, where drugs are given to counteract this effect, much larger doses of electricity than the ordinary can be borne. While artificial respiration may be of value in simply stunning, when larger doses have been taken, no rational means of resuscitation have as yet been suggested.

I was enabled to carry out the above experiments by the loan of apparatus kindly furnished by Professor Thomas, and was greatly assisted in the work by Mr. Boyd, of the Physical Department, who was present at every experiment, and who made the measurements for us.

The current was obtained from a surface wound alternator giving an approximate sine-curve. For potentials of 100 volts or less, connection was made with the secondary of a suitable transformer. Potentials of over 100 volts were taken direct from the primary circuit, adjustment being made by varying the generator field.

Voltages were measured by means of a Weston A. C. voltmeter. The mains supplying the current were of low resistance, so that the drop when the circuit was closed was found to be negligible. The figures given are the actual potential differences of the electrodes, while the current was flowing through the animal, correct to within one-half volt. A Siemens dynamometer was used for measuring the current when the time of contact was less than four seconds. It was somewhat difficult to make a setting, so that readings for these short times cannot be taken as correct within five per cent

Number.	Weight, (lbs.)	Volts.	Amperes.	Time, Seconds.	
1..	21	525	2	8	Artificial respiration 40 min.—Death.
2..	15	220	1.22	8	Artificial respiration 25 min.—Death.
3..	30	106	.4	10	Artificial respiration 1 hr. 15 min.—Death.
4..	42	98	.4	4	Artificial respiration 2 hrs. 30 min.—Death.
5..	27	96	.3	2	Artificial respiration 1 hr.—Death.
6..	21½	52	.3	1	Recovery.
				2	Recovery.
				4	Death.
				.5	Recovery.
7..	12	70	.32	1	Recovery.
				1	Recovery.
				2	Recovery.
8..	40	47.5	.25	4	Death.
9..	35	96	.35	1	Death.
10..	30	52	.25	2	1-30 grain atropine: Recovery.
				4	1-30 grain atropine: Death.
11..	28	52	.29	2	3-60 grain atropine: Recovery.
				4	3-60 grain atropine: Death.
12..	26	50	24	4	1-25 grain nitroglycerine: Recovery.
		97	.54	1	1-25 grain nitroglycerine: Death.
13..	30	48	.22	4	1-20 grain nitroglycerine.—Death.
14..	33	52	.22	4	4-50 grain nitroglycerine: Recovery.
		104	.6	4	4-50 grain nitroglycerine: Death.
15.	22	51	.32	4	6-50 grain nitroglycerine.—Death.
16..	22	47	.2	4	1-10 grain nitroglycerine.—Death.
17.	27	52	.2	4	1-10 grain nitroglycerine: Recovery.
		106	.55	1	1-10 grain nitroglycerine: Death.
18..	36	51	.25	4	80 grains chloral: Death.
19.	30	52	.24	3	1-50 grain atropine: Death.
20.	51	52	.24	3	Recovery.
			.25	4	Recovery.
			.30	6	Death. (22 deep respirations.)
21..	25	50.5	.2	3	Death.
22..	19	51	.2	3	Small dose nitrite of amyl.—Death.
23..	17	51	.2	3	Small dose nitrite.—Death.
24..	34	50.5	.2	3	Full dose nitrite: Recovery.
				6	Full dose nitrite: Recovery.
25..	38	50.5	.2	4	Full dose nitrite: Recovery.
		101	.2	6	Full dose nitrite: Recovery.
			.5	1	Full dose nitrite: Death.
26..	34	51	.12	4	Recovery.
			.18	4	Recovery.
			.2	4	Death.
27.	12	50	.2	4	Full dose nitrite: Recovery.
				6	Full dose nitrite: Death.

TURBINES AT THE NIAGARA PLANT.

Those who have studied the design of the turbines at the Niagara power plant will remember that the regulating gate is a ring that surrounds the turbine and governs the speed by partially closing the openings in the outer circumference, so, as it were, holding back the water and causing it to flow more slowly through the wheel. I was surprised to learn on a recent visit to the power house that when these gates are entirely closed there is still sufficient leakage to keep up a slow motion of about twenty revolutions per minute in the great dynamos, and that this cannot be stopped except by shutting the water off from the pen-stock, which conveys the water to the wheel—a proceeding to which the engineers do not wish to resort, because it would remove the upward pressure of the water and bring the weight of the whole mass, some 150,000 pounds, upon the thrust bearing while still in motion, or by the application of a brake. It is a matter of course, since the wheel must revolve inside the gate, that there must be some clearance. I was told that this was only one-sixteenth of an inch, which seems very small in view of the size of the turbines and the spend at which they run, but even a sixteenth of an inch around the entire circumferences of the upper and lower discs of both wheels, will, under a head of 140 feet, discharge a large volume of water. The impossibility of entirely stopping the wheels by closing the regulating gates was foreseen, and in the design of the wheels provision was made for the application of a brake.

Wm. A. Anthony.

Professor Crooks thinks that if the electric light were universal to-day the candle if suddenly introduced would be thought a wonderful invention, as it enables a person to obtain light in its simplest and most portable form and without the use of cumbrous machinery or the necessity of attaching the lamp to any fixed point by means of wire before it could be lighted.—*Chicago Tribune.*

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ELECTRICAL EQUIPMENT RULES.

Detailed Explanation of the Regulations Imposed by the City of Chicago and the Board of Fire Underwriters.

OF INTEREST TO ELECTRICAL CONSTRUCTORS.

This series of papers is not intended for the instruction of experts. Its object is to show to those who are unacquainted with the laws of electricity, the reason for and the philosophy of these rules and regulations. They will be taken seriatim, and thoroughly dissected in language which will be perfectly intelligible to the youngest student.

CONTINUED.

7. TESTING:—

a. All series and alternating circuits must be tested every twenty-four hours, to discover any leakage to earth, and a record of such tests submitted to the Electrical Inspection Department.

A record of the daily condition of the wires of a central plant is very important, not only to the authorities, but to the company owning the installation. A fault that otherwise might develop serious consequences may thus be found and remedied before harm is done. It may permit of the correction of a fault which is costing much in the shape of a leaking current, and under all circumstances it will verify the old saw, "a stitch in time saves nine."

b. All multiple arc low potential systems (300 volts or less) must be provided with an indicating or detecting device, readily attachable, to afford easy means of testing where the station operates continuously.

In low potential systems there is, or should be, a ground detector, by which at any time a temporary ground can be thrown onto the line, through a lamp, which will indicate by the glow of its filament the insulation of the line. This test is only an approximate one, however, and always indicates—if it brightens the lamp even a small amount—a condition of line which needs immediate attention.

c. Data obtained from all tests must be preserved for examination by inspectors.

These rules on testing to be applied at such places as may be designated by the Electrical Inspection Department.

RULE 8. MOTORS:—

a. Must be wired under the same precautions as with a current of the same volume and potential for lighting. The motor and resistance box must be protected by a double pole cut-out and controlled by a double pole switch located within sight of the motor, said switch indicating plainly whether "on" or "off"; except in cases where one-quarter horse-power or less is used on low tension circuit, a single pole switch will be accepted.

Motors, other than small fan motors, require to be carefully watched and made thoroughly safe in their first installation, because they place a current of deadly capacity in the hands of all who use them. The highest insulation attainable is none too good; every safeguard is sought to be thrown about them. Double pole switches and cut-outs which cut off both the positive and negative wires are required, so when the machine is stopped there is absolutely no chance for fire or personal harm. Even the current in the little one-eighth horse power fans used so generally in offices is potent for mischief, as many a scarred hand in Chicago can testify—and the greater the horse power the greater the capacity of the current in that direction.

b. Must be thoroughly insulated, mounted on filled dry wood, be raised at least eight inches above the surrounding floor, be provided with pans to prevent oil from soaking into the floor, and must be kept clean.

The necessity of preventing dirty accumulations which may become oil-soaked, and thus render spontaneous combustion possible, should be apparent to all, and the general neatness of the installation does not suffer from these reasonable requirements.

c. Must be covered with a waterproof cover when not in use, and, if deemed necessary by the inspector, be inclosed in an *approved* case.

From the nature of the question, the decision as to what is an *approved* case must be left to the inspector to determine in each instance.

A waterproof cover for a motor serves the two-fold purpose of keeping dust away from the machine, and in case of a burst ing pipe, an overflow from a basin or closet, may save anywhere from one to three hundred dollars in repairs of the motor. Very little moisture on a dynamo or a motor is fatal to its usefulness, and the motor re-wound from such a cause carries its own conviction with it, and generally has a cover afterward.

9. RESISTANCE BOXES:—

a. Must be equipped with metal or other non-combustible frames.

The word "frame" in this section relates to the entire case and surrounding of the rheostat, and not alone to the upholding supports.

b. Must be placed on the switch board, or at a distance of a foot from combustible material, or separated therefrom by a non-inflamable, non-absorptive, insulating material.

c. Starting boxes must be so arranged that resistance cannot be left in circuit.

A starting box through which the current flows is a series of coils, similar to the rheostat explained before. The lever is gradually moved over the contact points, cutting out more and more resistance, and giving the motor more and more current, until it attains its full speed, when the resistance box is entirely out of the line.

Now, if for any purpose the lever is left on one of the intermediate buttons, the current flowing through the coils between that point and the full "off" stop will engender heat. The quantity of heat depends on the resistance in the coils and the current flow.

It is not unusual for parties who are ignorant of the consequences, to leave a starting box lever on one of the intermediate buttons, to move a fan slower, or for some other purpose, and in some instances where the lever was used instead of the switch, to cut off the current, the lever has been left part way over on quitting for the day, with a fire result before daybreak the next morning. In addition to this a starting box is usually a single pole affair, and does not cut the current clear from both sides of the motor.

(TO BE CONTINUED.)

COMMUNICATION.

MADISON, Wis., July 6, 1895.

ELECTRICAL JOURNAL, Chicago, Ill.

GENTLEMEN—It will probably be of interest to your readers to learn that the University of Wisconsin has conferred the honorary degree of LL. D. upon two men of national reputation on account of their great services in the interest of engineering and the industries.

The first of these men is Edwin R. Reynolds, of Milwaukee, Wis., designer and builder of the Reynolds Corliss engine. The degree was conferred upon Mr. Reynolds in recognition of his position as an expert of the righest rank and of international authority as a steam engineer, and on account of his remarkable ability and success as a designer and inventor.

The second of these men is Don J. Whittemore, of Milwaukee, Wis., chief engineer of the Chicago, Milwaukee & St. Paul Railway. The degree was conferred upon him in recognition of his distinguished services in the railway interests of the country.

Respectfully yours,

D. C. JACKSON.

The electric locomotive built to do service in the Baltimore tunnel has proven itself to be quite a triumph of electrical engineering skill, but there is still something more to be accomplished before it can be called a complete success. A few days ago when it was given twenty-four cars and an ordinary steam locomotive to pull, it succeeded in making only a short distance when it was found that the shoe of the trolley was red-hot and the connection between the shoe and car broke. The engineers say, however, that the trouble experienced can be remedied.

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MUNICIPAL LIGHTING.

Canadian cities are agitating the adoption of municipal lighting, with municipal ownership of lighting plants. The city engineer of St. Thomas has been making some exhaustive investigations on the subject, both in the United States and Canada. He has reported that in the United States the highest cost per lamp per year in cities that do their own lighting is $66.00. His report for Canada states that only one city, Windsor, does its own lighting, and that the reported cost, 14½ cents per lamp per night, presumably covers only the cost of operation. The reasons he advances in favor of municipal ownership are:

1. In the construction of a municipal station the municipality saves the profit that a private company would expect to make.

2. A city is generally in a position to borrow money at a lower rate of interest than a private company.

3. Most of the plants owned by private companies in the large cities were put in some years ago when the cost of electrical appliances was greater than it is today, while their efficiency was less.

4. In the construction of a private plant capitalists will not risk investing money unless they are assured of good dividends, while all the municipality requires is a sufficient return to pay the cost of running, including interest on the outlay, with a margin for renewals.

5. A company operates usually under a franchise which is not exclusive, and under a contract which is made for a short term of years, making it inadmissable to venture capital unless the returns are so large as to warrant taking the risk.

6. There are reasons for believing that a city can, by letting contracts publicly, erect more cheaply than a company, which obtains the machinery by private contract.

Against these reasons stand the following:

The company furnishing light, heat and power being given a secure franchise, can, by a slight additional investment, make the capacity of its apparatus sufficient to do the municipal lighting at a much less cost than could a plant erected for street lighting only. (a) The liability of loss from fire, (b) the destruction of poles and circuits from storms, (c) danger from broken wire or defective insulation, and the possibility of costly litigation, damages from lightning, instances of which are in existence where as many as three armatures burned out in the course of a year costing $1,500; (e) the probability of great advancement in electric generation and transmission in the near future.

RAPID TRANSIT.

The public has become so accustomed within the past few years to improvements in the direction of rapid transit, that hardly any proposition in that direction now seems too impossible for realization. From the days of the old stage coach, down to the present time, it has been one continued succession of advances commanding the wonder and admiration of the world, and the end apparently is not yet. Had any one predicted to the early pioneers of the West that within the life time of many of them the distance between New York and Chicago would be made within the limit of the 24 hours, he would have been accounted of unsound mind, yet not only has this been accomplished, but it is an every day occurrence, and occasions comment only when for any reason the train fails to get in on schedule time. But even the most visionary of mortals will hardly be prepared for the proposition to reduce the time over this same route to ten hours or less as is contemplated when that $200,000,000 elevated and electrically equipped line is built, and yet it requires possibly no greater credulity to believe that it will be accomplished than many things which were once deemed not only improbable, but impossible, and which have since become matters of regular occurrence. It has already been demonstrated that a speed of 100 mines an hour is obtainable over short distances, and it will soon be known whether it can be maintained for an indefinite distance, and whether it will be safe to spin along at such a break-neck pace. If these points should be decided in the affirmative, then the mere mechanical construction and the attendant expense will be matters comparatively easy to surmount. Imagine conducting business up to the close of one day in New York and being on hand in Chicago at the opening of business the following morning with time for breakfast in the interim!

THE MICRO-STETHESCOPE.

Dr. Lawrence Stevenson of New Orleans has invented an electrical micro-stethescope by which the sounds of the body can be submitted to the ear sufficiently magnified to make them quite audible. In illustration of the extent to which this may be done, it is said that the instrument will magnify the noise made by a fly walking, until it can be heard distinctly, and the fly's wings also heard. By attaching to the instrument a number of receivers it is made possible for sounds to be heard by several persons at the same time.

EVOLUTION OF THE STREET CAR HORSE.

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

VOL. I. CHICAGO, JULY 15, 1895. NO. 4.

The Electrical Journal.

The following interesting editorial is clipped from the *Western Electrician:*

The first number of the *Electrical Journal* of San Francisco is out. This is Geo. P. Low's paper, and its pending appearance was mentioned in the WESTERN ELECTRICIAN several weeks ago. It is a monthly, of handsome appearance, and from the quality of the first issue gives promise of being an important factor in the electrical advancement of the Pacific Coast region. The editors—Mr. Low and Dr. Perrine—are to be congratulated.

It is a curious coincidence that this venture and Supt. Barrett's semi-monthly for the students of the National School of Electricity were both projected about the same time, and that for both the name *Electrical Journal* was selected. To add to the confusion, the new comers are strikingly similar in size and external appearance. Mr. Low appears to have been first in announcing the forthcoming appearance of an *Electrical Journal*, but Supt. Barrett certainly anticipated him in actually placing an *Electrical Journal* in the field. Now that both enterprises have been launched, the situation is somewhat complicated. For obvious reasons the conductors of the San Francisco *Electrical Journal* will not care to have their carefully edited review confounded with the *Electrical Journal* of Chicago, while the latter, in its turn, will doubtless wish to be known as a Chicago publication distinctively. To avoid a constant source of annoyance, therefore, it will be well for one of the new journals to change its name; or, if this cannot be agreed upon, let each incorporate a geographical designation in its title, as the *San Francisco Electrical Journal* and the *Chicago Electrical Journal*.

We feel in duty bound to express our appreciation of the concern which our contemporary manifests in the welfare of THE ELECTRICAL JOURNAL and to thank it for the kindly advice. We might suggest, however, that it would be a misnomer to incorporate the word "Chicago" in the title of THE ELECTRICAL JOURNAL, or even the word "Western," as our territory is not circumscribed, and we shall hope to be allowed to regard ourselves as THE ELECTRICAL JOURNAL of the world.

The extract from the letter of Dr. Perrine, as published herewith will perhaps serve to allay the uneasiness of our anxious friend. If not, we shall be pleased to furnish him with any other information on the subject that will help to set his mind at rest.

FREEHOLD, N.J., June 30th, 1895.

J. ALLAN HORNSBY,
Chicago, Ill.

DEAR SIR,—Yours of June 11 has been forwarded to me here. Mr. George P. Low and I have been working up a paper, which by a curious coincidence we intended to call the "Electrical Journal," but as you are the prior in the field by a few weeks I suppose that we shall have to change our title. * * * I am very sorry that this has happened so, but I had no means of foreseeing that you were intending to start a journal.

Yours truly,
FREDERIC A. C. PERRINE.

While we are on this subject, there is another matter that we might dispose of and thus obviate the necessity of referring to it again. It is to ask permission of our esteemed contemporary, the *Western Electrician*, to tarry for a season upon the face of the earth. If our presence and our success is a thorn in its side, we regret to be the cause of its discomfiture, but the exigencies of business demand that we shall get all the subscriptions and all the advertising that we can and to furnish the best paper that capable editorial talent can produce. If, in the attainment of these several ends, we crowd our neighbors, we plead an entire absence of malicious intent and beg that they will regard it more in the light of their misfortune than our fault.

Finally, we beg to give assurance that THE ELECTRICAL JOURNAL and the publication of Dr. Perrine and Mr. Low can adjust what is merely an unfortunate coincidence, to their mutual satisfaction, and as our Golden Gate contemporary is a handsome paper, well edited, and something after our own style, we predict and hope for it a large measure of success.

Electrical Executions.

The recent execution of Buchanan, with the accompanying details published in the daily papers, calls attention once more to the use of the electric shock as a means of carrying out the death penalty. It is difficult to conceive of a much more revolting spectacle under the old regime, than was presented at this and all other electrical executions. A number of eminent physicians are gathered in the death chamber not only to witness but to take official part in the execution. The condemned man is brought in, strapped securely by strong leather straps into the death chair, and the electrodes fitted to the head and legs. At a given signal the current is turned on, there is a most violent muscular contraction that would, except for the secure bindings, have thrown the man from the chair. Then follows a smoke and smell of burning flesh. The current is turned off, the body becomes limp, one of the physicians tears open the shirt and listens for the heart beats. He exclaims that the heart is still beating. The wires are again hastily connected, and the current turned on a second time. There is more muscular contraction, more burning flesh. This time the several physicians in turn listen for the heart beats, and pronounce the man dead. The body is taken from the chair, laid upon a rough table and cut up according to law.

These are the details as given in the daily papers, in one of which the reporter writes over his own signature. They may be exaggerated, but there can be no doubt that death by electricity is anything but the calm and peaceful death that the authors of the law were seeking to provide for the condemned murderer.

Why was electricity chosen as the agent? Why not any one of several other means of causing death? I can conceive of no reason except that the effects of electricity were least understood, and there was the least actual knowledge of how best to set about it to kill a man by this means. No one even now knows exactly how electricity kills. Recent experiments by Dr. Bleile, of Columbus, Ohio, remarkable for the ingenious and thoroughly scientific methods by which all the effects have been studied, have thrown new light upon the subject, but even today we are very far from knowing, with the precision with which other causes of death are known, just how death is caused by the electric shock. Neither do we know how to apply the current. Certainly if there is no less cumbersome apparatus and no less clumsy method available than that in use at Sing Sing, this of itself is sufficient reason for abandoning this mode of executing criminals.

It is often claimed in behalf of electrical executions that

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death is instantaneous and painless. In no report that I have ever seen is there any evidence of instantaneous death. All the evidence that can be gathered from reports of accidental shocks goes to show that resuscitation is possible if the exposure to the current is of short duration.

Painless no doubt it is, but so would be the effect of a pistol shot through the brain. And why not use a pistol shot for executing a criminal? He might be strapped to a mattress, a semi-circle of pistols arranged around his head terminating at the temples, and, if desirable, another group could be placed over the region of the heart. If electricity must be employed, arrange to fire the pistols simultaneously by pressing a button. Why not? Would it be more uncertain? Would it be less humane? Would it be more blood-curdling? Would it be less "instantaneous"? But, perhaps, there would be too little mystery about it, and too little complicated apparatus required. There would be no need of cutting a man up to see what killed him, or whether he was really dead.

If we must inflict the death penalty and wish to be really humane about it, there are surely many ways by which death can be brought swiftly and certainly without inducing muscular contortions, or burning the flesh, or mutilating the body. The criminal could be given a sleeping draught and then laid out in a glass case, which could then be filled with the fumes of burning charcoal.

I see no reason why we should seek to make death particularly easy to the criminal. I look upon the whole scheme of capital punishment as a hideous blot upon our civilization, but if a man *must* be punished with death, it is certainly not upon the theory that he must be put out of the way in the easiest possible manner for him. It is assumed that the dread of the death penalty will prevent crimes that otherwise might be committed. The penalty, if it is to be inflicted, should come in a form to be dreaded, yet there is no excuse for torture, or for the semblance of torture. The criminal should come to his fate with a full knowledge of what awaits him. The execution of the sentence should be by a method that is swift and sure, without mystery, and about the effects of which there is no uncertainty. There should be no opportunity for doubt as to the result, and no reason or excuse for a repetition of an operation. Electricity does not fulfill these requirements and never can until we know far more than we do at present of its effects in the human organism. If we knew all we ought to know to warrant its use, I believe an instrument that could be carried in the pocket would accomplish the results as surely as the hundred horse power engine and dynamo now employed.

It is to be hoped that civilization will soon abolish the whole barbarous system, but while the system lasts let us put into the hands of the executioner an instrument that he understands and about the effects of which there is no mystery and no doubt.

Wm. A. Anthony.

The Dividend Question. II.

In general terms, we may say that an incandescent electric light company should receive pay from its consumers for an amount of current which is equal to from sixty to eighty per cent. of the output of its station. In a well-built, continuous-current plant the consumers' meters will usually give an aggregate reading from month to month which equals this per centage of the total recorded output of the station, as shown by station records or by feeder meters. The difference between the station output and the aggregate reading of the consumers' meters represents *lost power*, which costs money to produce and wastes the capacity of the station. It is possible that the losses may be so great that the dividend-earning capacity of the station is reduced or ruined. The wastes in a continuous-current plant which come between the station switch board and the consumers' meters are due to power lost on account of the resistance of the distributing lines (this is evidenced by the drop of pressure between the station and the meters), to leakage of the current from poorly insulated conductors, and to errors in the meters. If the lines are kept in good condition the total distributing losses in a continuous-current plant of average size should not exceed twenty-five per cent., and may, perhaps, by great care, be reduced to twenty per cent. The difference between twenty and forty per cent. may so tell on the coal pile and on the capacity of the station as to decide the dividend question, and, therefore, complete records of the output and sale of electric current from the station are of the greatest importance to show the superintendent where leaks may be stopped.

In the case of alternating-current electric light stations, the high pressure at which the electric current is distributed makes it possible to reduce the loss in the conductors, but the transformers which are required to reduce the pressure for the consumers' use introduce a loss which is more than compensating. In many alternating-current plants the power wasted by the transformers costs so much that, in the same situations, continuous-current plants with all their limitations, would be far more likely to pay dividends. It is no uncommon thing for a small alternating plant to put out from two to four times as much power as is used by its customers. Nearly all this difference between the consumption and the output is lost in the transformers. Plants operating under such unfavorable conditions can never earn dividends. Such conditions are not a necessary evil of alternating current distribution, as experience shows that the losses may always, by proper care, be reduced to forty per cent. of the output, and under favorable conditions the losses may be brought down to as litttle as twenty-five per cent. This may be done through the careful selection of transformers, without sacrificing any of the flexibility which belongs to the alternating current distribution. *It does not pay to buy a transformer because it is cheap; it does pay to buy the transformer of reasonable price that wastes the least power.*

Every transformer purchased by an electric light company should be tested before it is put on the line, and if it wastes an unreasonable amount of power it should be condemned and returned to its manufacturer. This question will be fully entered into in a paper to be read by the writer at the Chicago meeting of the Northwestern Electrical Association. It is only a few minutes work for a station superintendent to test each new transformer, as will be shown in the paper referred to, and a superintendent who does not make such tests risks his company's dividends. The more hours per day a plant runs, the more urgently is this testing required, because the transformer losses continue as long as the plant runs, while the heaviest sale of current only lasts for a few hours at the most.

D. C. Jackson

Death by Electric Shock.

The precise nature of the primarily fatal physiological action set up in cases of death from electric shock seems at last to be definitely settled. At the Niagara Falls meeting of the American Institute of Electrical Engineers, Dr. A. M. Bleile, Professor of Physiology at the Ohio State University, read a paper giving an account of his experiments on dogs subjected to electric shock by contact with alternating current circuits. We publish the paper in this issue of THE ELECTRICAL JOURNAL. The results may be briefly stated as follows:

The least shock that is sufficient to kill a dog of thirty to fifty pounds weight is about 50 volts, ½ ampere, applied for four seconds. A decrease in either factor requires a corresponding increase in one of the others. The primarily fatal action is not on the brain, nor on the lungs, nor on the heart. It consists in the production of an energetic contraction of the muscular fibers surrounding the arteries, closing the arteries and preventing the passage of blood through them. The stopping of the beating of the heart, and of respiration and other vital functions,

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are secondary effects. The correctness of the explanation is proven by the use of appropriate drugs. Artificial respiration can not restore to life when the arterial contraction is thoroughly established. Drugs can not restore, for the reason that they can not be carried to the place where they are needed, the blood circulation being stopped.

The arterial contraction continues for an undetermined length of time after death, the length of time probably varying with the severity of the shock. Resuscitation may be possible, if the arterial muscles relax soon enough, or if some method can be found to cause such relaxation. The only method that seems to promise a favorable result is the application of high frequency currents, as suggested by Prof. Elihu Thomson during the discussion of the paper. Dr. Bleile proposes to try their effect.

The doctor stated that while artificial respiration seems hopeless, when the fatal condition has been fully established, a vigorous and long-continued effort should be made to restore any one who has been accidentally shocked, taking the odd chance in thousands for the saving of a life.

Benj. F. Thomas.

* * *

The Motor Carriage Contest.

The offer of $5,000 in prizes for motor road carriages, made by the *Chicago Times-Herald*, as published in another column, means much to the electrical people, especially those interested in the storage battery business.

Some years ago street railway managers were experimenting with petroleum, gas, naphtha and other motors. Who ever hears of these experiments now? And why do we not hear of them? Simply because there is no longer a doubt that electricity is superior to all for this class of service. Later, a motive power for small water craft seemed to be demanded, and the experiments culminated at the World's Fair in a complete victory for electricity. The same story might be told concerning numerous smaller trials which have attracted little public interest because of their special and limited bearing.

Mr. Kohlsaat's offer has brought conspicuously to the front another trial for supremacy, and one in which every man, woman and child in the land is interested to an unusual degree; and, strange as it may seem, very few people have appreciated the importance of the subject until we are brought up against it with that sharp "jolt" that has characterized the movements of the *Chicago Times-Herald* ever since Mr. Kohlsaat became its proprietor.

The bicycle people have greatly revived the demand for good roads, and the rest of us have apparently been satisfied with other means of transportation, preferably the railroads. But suddenly we have our eyes opened to the fact that the horse is rapidly going out of favor—perhaps owing to his inability to travel fast enough to keep up with the age, while we have not provided ourselves with his substitute for reaching those innumerable places not accessible by railroad. The electrical people have the recent Paris occurrence in proof of the fact that they will have to travel fast to win. They will have to do better than they have ever done before, for there are many difficulties in the way of storage battery success for road carriage service. Those who propose to go into this contest may as well decide that they will have at least twenty miles an hour to beat for several hours. At Paris, an average of sixteen miles was made by the winner, but the distance was 750 miles, while we understand that Mr. Kohlsaat favors a sharp drive from Milwaukee to Chicago, a distance of about 90 miles.

We believe that electricity can win this contest, but we also believe that electricity will have to hustle. There is work to be done between now and November, but the first prize of $2,000 will be a bagatelle in comparison with other rewards which will fall to the victor.

Pleasures of Street Car Riding.

The *Street Railway Journal* for June has a most interesting and instructive article on the street railway systems of St. Louis, Mo. An epitome of the article is that there are 291 miles of street railway in the Mound City, of which 245 miles are operated by electricity, 34 by cable and 12 by horses. In 1890, just about the time the roads were changing to electric power the passenger traffic amounted to 68,105,561 nickels. In 1894 the figures had increased to 95,201,770, making an increase of about twenty-seven million, or more than 30 per cent.

This increase would be truly marvelous if figured solely upon the increase in population, but this cannot be done. There are other elements of greater importance. In the first place many people would rather walk than ride in a slow going horse car such as St. Louis used to have. Again, since the electric cars have come into vogue, the road managers have banded together to make entertainment for the people at the parks on the outskirts of the city, in the shape of concerts, boating matches, picnics and games, but beyond all these, another element must be considered, and that is the pleasure of a rapid, smooth and breezy ride, in a vehicle under circumstances which do not include the suffering of broken down horses, or the rumbling jerkiness of the cable. In St. Louis thousands of people, young and old, go for a ride on the electric cars into the suburbs, and a walk through the magnificent parks every afternoon. All these elements enter largely into the increase in passenger traffic in St. Louis, and equally so in other places. Street railway managers pay too little attention, as a rule, to the supplying of a motive to induce people to ride on their cars. Mr. Yerkes had this in mind when he built his electric fountain in Lincoln Park, Chicago, and again when he took a hand in securing the location of the Ferris Wheel on the line of his road.

* * *

The Study of Light.

In our number of August 1, will be commenced a series of articles by Dr. B. F. Thomas, of the editorial staff, on the subject of "Photometry, or the Measurement and Study of Electric Light." The whole science of light will be discussed, including the measurement of arc and incandescent light, the distribution of light for ordinary commercial purposes, and the special lighting of auditoriums and theaters. We regard this subject as a very live one just now, intimately associated, as it is, with the business economies and methods of central station managers, electrical engineers, designers and installers of electrical plants, electrical workers—in fact, all who have to do with commercial electricity.

* * *

We have not the pleasure of the acquaintance of Superintendent Whistler of the Wisconsin Telephone Company at Eau Claire, Wis., but from his actions we judge him to be a crusty old bachelor whose nature belies the sentiment that "all the world loves a lover." It seems that the young people of Eau Claire and Chippewa Falls have been in the habit of sparking over the inter-urban wire when it was impracticable to "coo" at shorter range. In doing so they have neglected to observe the little formality of paying tolls. Superintendent Whistler affects to see in the practice a menace to the interests of his company, and he purposes putting a stop to it. He probably has forgotten if he ever knew that love laughs at obstacles, and that it thrives in proportion to the difficulties placed in its way, but he will probably live and learn.

Our blue contemporary seems to be in pain. Is it possible that some one has been stepping on its toes? One rarely cries out in the vehement language it has been using in its last issue or two unless it has been hurt. We would regret to know that THE ELECTRICAL JOURNAL has jostled it any, and if so, we sincerely apologize, and offer in paliation, that the road to success is a narrow one, and in passing it we may have been so heedless and rough as to hurt it. If our wind holds out—and we think it will—we can safely promise that the road in our rear shall be left safely clear for our friend.

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Governor Hastings of Pennsylvania, in his veto message of what has become known as the electric light monopoly bill, said that "monopoly in so important a matter as light should certainly not receive executive sanction." It seems to us that the principle laid down by the Governor in this connection is susceptible of very general application without doing violence to any great public interest.

By a peculiar coincidence the first real work that the Niagara plant did was in connection with the manufacture of aluminum. Just think of it! ten years ago who would have predicted that Niagara would be in long distance harness plowing in virgin fields of chemistry, and making for commerce what was then simply a scientific possibility!

Truly, "'tis a mad world, my masters." Until city electrician Barrett, of Chicago, became interested in the publication of an electrical journal, the enormity of his sins of omission and commission were not perceptible to the genial editor of the *Western Electrician*. What a difference it makes whose ox is being gored!

Boston contemplates building a municipal subway for street cars. We suggest that she connect a few of her Chinese underground habitations with a few of her beer tunnels. She might smoke out the Chinese and drink the beer, and thus have a clear right of way without condemnation proceedings.

Again the General Electric is to move. This time it is to Depew. We always knew Chauncey was a pretty big man, yet —yet—how would it do to give a good dinner at the old works, and see if "de Peach" could not be persuaded to go to the General Electric?

We mean no reflection on the residents of Barr street, Cincinnati, who object to the arc lamps "because the light shines in their faces," but it is recorded that "men love darkness rather than light because their deeds are evil."

Collectors of pre-historic specimens will be stealing those rare relics yclept "electrical experts" in the government patent office unless precautions are taken. They should be under lock and key in the Smithsonian Institute.

The Legislature of Pennsylvania would have bound the Quakers hand and foot and delivered them in bondage to the electric lighting combine, but Governor Hastings quietly vetoed the proceeding.

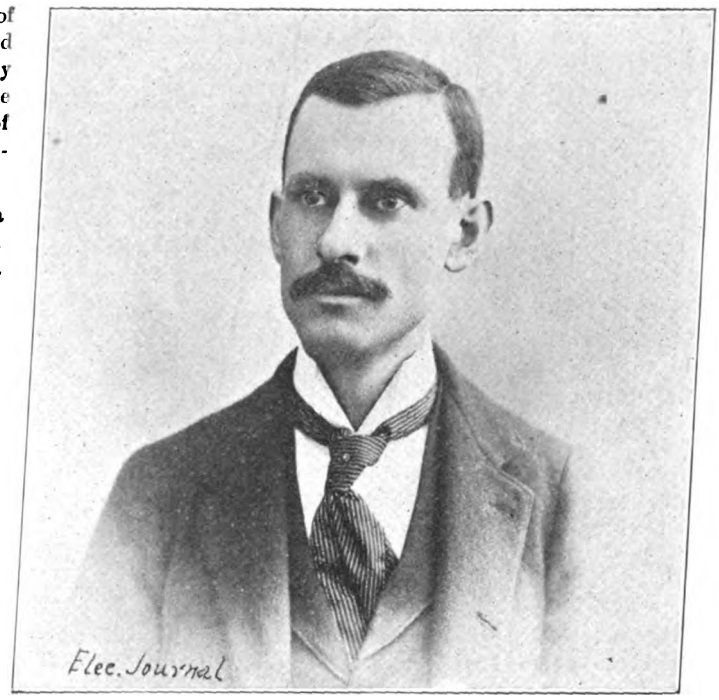
Mr. Kohlsaat, of the *Chicago Times-Herald*, wants a name for the horseless carriage. Who wants to promenade down the aisles of Time in the funeral procession of the "poor old horse"?

We would suggest that somebody distinguish himself by inventing something that has nothing to do with electricity. We know it will be difficult, but for that reason interesting.

A horseless carriage by any other name would go as fast, and almost any other name would sound more ephonious.

The modern way of advising an irate friend to "keep cool" is to tell him to go and invest in an electric fan.

Uncle Sam has fallen out with the International Stamp Company, the owners of the electric stamping machines used in the larger post offices of the country which were capable of stamping 40,000 letters an hour. As a result the machines have been taken out. The difficulty arose over the question of royalties to be paid. The loss of this convenient apparatus means going back to the former method of stamping the letters by hand until the difficulty can be bridged over. Incidentally it would be interesting to learn when, and by whose influence, and under what conditions the machines were adopted, and who owned and controlled them. There have been things said about the ownership of these machines that reflect on high officials of the former national administration.



CHARLES F. SCOTT.

Mr. Scott is very well and favorably known to the electrical fraternity as a gentleman of high attainments in his profession. He was born in 1864 at Athens, Ohio, and in consequence is just now at that point in life when the full vigor of manhood can be drawn upon to carry out his plans and ambitions. His early education was obtained at the Ohio University of Athens, and later at the Ohio State University of Columbus, from which latter he graduated in 1885 with honors. He subsequently took a post graduate course at Johns Hopkins University, and in 1887 began the practical application of his profession in the form of construction work in Philadelphia. The following year he engaged with the Westinghouse company and has continued in its service ever since, commencing first on night duty in the dynamo room, from which he graduated to the laboratory, where he assisted Mr. Tesla in his work on alternating current motors. Later on he was given charge of the experimental work on the Tesla Motor, and after a time was appointed assistant electrician. At the present time he occupies the responsible position of Chief Electrician, and is a valued factor in the work being carried on by the great corporation with which he is identified.

NORTHWESTERN ELECTRICAL CONVENTION.

The members of the Northwestern Electrical Association will convene in Chicago on the morning of Wednesday, July 17th. The meeting will continue for three days, and will be attended by 150 to 200 members, mostly central station men. The morning of each day will be devoted to business, including the reading of papers and the election of a president to fill the vacancy caused by the death of Mr. T. H. Thom, who formerly filled that position. The afternoons during the session will be devoted to sight-seeing and pleasure, among other diversions arranged for being a visit to the stations of the Metropolitan Elevated Railway and the Edison Company, a trip over the Santa Fé to the Drainage Canal, a drive through the city parks, and an evening at the theater.

"They do say," remarked Mrs. Dolan, "that a shock by electricity don't entirely kill a man."

"Maybe not," replied Mr. Dolan. "But thot's phwere the faith cure idee worruks backwards. It convinces yez so completely thot ye're dead thot yez hoven't the courage to come to loife.—*Washington Star.*

Any one desiring to keep abreast of the times in electrica matters should be a subscriber to THE ELECTRICAL JOURNAL.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students. Personal and Pertinent.

STORAGE BATTERIES.

Written for Students of the National School of Electricity by Alvaro S. Krotz, Instructor, Springfield, Ohio.

The slow development of the storage battery is probably due in part to the fact that attention must be given in their design to three branches of science, viz., electricity, chemistry and mechanics.

So far as electro-chemical action is concerned, the storage battery has been very greatly perfected, and improvements are continually being made. These improvements are mainly in the line of producing greater porosity of the active material and still adhering to other necessary conditions.

It will not be necessary to go into the details of original discoveries and the early forms of storage batteries. The common storage battery is built up of lead plates, or of lead grids or holding frames into which a red oxide of lead—either litharge or minium, which has been previously mixed with acidulated water—is pasted. Plates thus formed are placed in cells filled with dilute sulphuric acid and connected to the charging circuit. The plate or plates connected to the positive wire are the positive plates of the battery. Upon these, peroxide of lead collects or is formed by the union of oxygen with the pasty material. Hydrogen collects on the opposite or negative plate, reducing the material to spongy lead. The plain lead plates require much time and expense for perfecting complete formation, because of the repeated charging and discharging necessary.

A very serious defect has developed in both these forms, especially in the pasted plate batteries, and that is the falling off of the active material as it becomes porous. If the material were made very solid and dense by pressure or other means, other faults equally serious would develope; there would be a low efficiency when at a high rate of discharge and buckling or twisting of the plates. It is evident that for all practical purposes the active material should be very porous, and no metal or conducting material should be in direct contact with the electrolyte *save* the active material, or, in other words, the active material or oxides should completely surround the conductor. This would prevent local action and buckling and give high efficiency from the fact that the porous active material would readily take up the gases over the entire surface evenly, and no one portion of the surface of the plate would charge or discharge sooner or later than the remainder. If all parts charge alike and freely, contraction and expansion must be equal over the entire plate. The electrical pressure would also be the same over the entire surface as it varies with the amount of charge.

Now, suppose we have a battery with the grid exposed at the surface of the plate, fully charged, and subject it to a heavy discharge for a short time. This would almost completely discharge the thin layer of oxide from the lead grid, reducing the electrical pressure at that point compared with that of the active material pellets which have lost but little of their entire charge. It is evident that local action would take place.

We have now come to the point of choosing a form of plate. This should, no doubt, be of thin lead, or a non-oxidizable alloy conductor, upon which is pasted a very porous, active material. But it has been found that the active material disintegrates and falls to the bottom of the cell, so we are forced to decide upon some insulating retaining wall, which has within itself sufficient strength to retain the material. This would be easy if it were not for the fact that it must be a porous, absorbent material. Each plate must also have its own supporting wall, so that a space can be left between walls for the circulation of the acid and free escape of gases. If we were to overlook the evils resulting from the absence of an open space between plates, and let the circulation and gases take care of themselves, and simply separate the plates with a porous absorbent insulating material, such as asbestos, or a matting of celluloid or other material, we might apparently have a good battery, but in time we would find it incapable of retaining a charge. The insulating material answering as a holder for the active material would be found to have upon it what are known as trees, or little streaks of lead, forming conductors which short-circuit the cell.

In summing up, we therefore find that the ideal storage battery must have its plates completely covered with porous active material; that this active material must be held in place by a porous absorbent wall, and that between the walls of the adjacent plates, there must be an open framework of solid materia to permit the free passage of gases and acid.

Let us now see where we would stand as to weight under the construction named. We will allow ten per cent. for conductors and ten per cent. for retaining walls. Under these conditions it would be an easy matter to build a battery with from six to eight ampere hours capacity per pound of battery. Thus, a battery with a capacity of ten horse power hours would weigh considerably less than five hundred pounds. A street car could then carry batteries enough for a day's run. A single-seated buggy would run ten hours on one charge, with batteries weighing little more than two men, and at a cost of not more than twenty cents. Batteries could be used for ballast in boats, comparing favorably in weight with that of ballast, engine, boiler and coal supply for a run of equal length of time. The power for charging the batteries might come from the source from which vessels were originally and at present propelled, as it would be an easier problem to get power with stationary wind engines than upon water. One thing is certain, plans for charging would be forthcoming, if a proper battery were presented to the people. Wherever electrical appliances are in use, storage cells would be in demand, and a great many new fields opened up for electrical appliances.

WELL DONE!

It is extremely pleasant to be in receipt of such resolutions as the following, which comes from the Cincinnati classes.

CINCINNATI, July 3, 1895.

To THE ELECTRICAL JOURNAL, *Chicago, Ill.:*

GENTLEMEN: Pursuant to the request of the Consolidated Classes of the National School of Electricity, I transmit to you a copy of a resolution passed at the final meeting of the classes, and ask that it be inserted in THE JOURNAL.

Be it Resolved, by the Consolidated Classes of the National School of Electricity, that we hereby tender our hearty thanks to our Instructor, Thomas J. Creaghead, for his earnest and highly successful efforts to instruct us in the principles of electricity.

Our meetings have been profitable and enjoyable; profitable because of the concise and lucid exposition of the science, and enjoyable because of the uniform kindness observed in its presentation; and while many of us have not learned all that could have been learned from the lectures, yet this is in no wise attributable to any lack of intellectual "voltage" in our Instructor, but rather to the great "internal resistance" of ourselves; and in separating, we, and each of us, sincerely wish that our Instructor may have a career in keeping with his eminent talents—talents which, we are assured, must always heavily "insulate" him from adversity and forever prevent "short circuits" and "burn outs" in the financial world; and we trust that it may be many years before he or any of his form that heavy "ground connection" which still seems to be the sad fate of all men, despite the miraculous advances in the electrical science.

The members of the classes will be greatly obliged if you will have the foregoing resolution inserted in your next issue.

Yours very truly, STANLEY J. BOWDLE,
Sec'y and Treas.

The newest Class of the School, and the one farthest west, is at Tacoma, Washington. The School now stretches from Boston on the East to Tacoma on the West, and from Duluth, Minn., to New Orleans on the South, with classes in every city of any size, excepting Baltimore, Md., and Washington, D. C., where no work has been yet attempted.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

The Missouri and Kansas Telephone Company of St. Joseph, Mo., is preparing to build ten miles of underground conduit for its wires.

If things go much further, the telephone girl bids fair to follow the "poor old horse" into innocuous desuetude. Still, she can burst her cocoon and be a "new woman."

The report that the Western Union and Bell Telephone companies would engage in a conflict for telephone business at the expiration of the present contract between them, which terminates at the close of this year is denied by the Western Union people.

The Interior Department, at Washington, has bought outright from the Western Telephone Construction Company 140 telephones at a cost of about $6,000. The cost of maintenance, said to be something like $400 a year, is the only expense that will be attached to the service hereafter.

The report that the Standard Telephone Company had secured or was about to secure control of the Postal Telegraph Company with a view to entering the field as a competitor of the Bell Telephone Company is emphatically denied by Vice-president William H. Baker of the Postal Telegraph Company.

Light and Power.

St. Paul, Minn., is fighting vigorously against overhead wires.

The affairs of the Loutsiana Electric Light Company continue to occupy the attention of the courts.

An electric plant is being built at the north fork of the San Joaquin river in California, and will deliver power to Fresno, a distance of thirty-five miles.

Springfield, Mo., has just closed a contract by which it will be furnished 150 arc lights at a cost per annum of $77.50 each, and incandescent lights at 40 cents per month.

Philadelphia is said to be the best lighted city in the country. At the beginning of the present year it had 5,293 electric lamps, 24,573 gas burners and 10,599 gasoline lamps, and the number of each kind is being continuously increased. It has the distinction of paying more, too, for its lighting. Electric lights cost 41.15 cents per night, a figure higher than is paid by any other large city.

Railways.

The Board of Railway Commissioners, at San Francisco, claims to have jurisdiction over electric street railways which operate beyond corporate limits and carry passengers and freight, and contends that it should have the power to adjust rates of freight. The matter has been referred to the Attorney-General for his decision.

Chicago is bound to have rapid transit, and is willing to take chances with the trolley. An ordinance has just been passed granting the right to run electric cars along Clark street in the downtown crowded district. Notwithstanding that the press and a portion of the public made vigorous opposition, the vote in the city council stood 61 to 6 in favor of the measure.

A little over a year ago there were not to exceed twenty-five miles of electric street railway within the city limits of Chicago. To-day there are nearly 200 miles in operation, and it is estimated that by the end of the year there will be added an additional 100 miles. The 186 square miles comprising the City of Chicago is becoming a regular cobweb of car lines, and transportation between any and all sections is easy and rapid.

The narrow and crooked streets of Boston have become so congested with the electric car service, and general traffic is so impeded that it has been found necessary to adopt a system of subways as a means of relief. The cost, exclusive of land damages, will be about $4,000,000. Real estate and land damages will add another $1,000,000. This will provide 5,600 feet of double track subway and about 3,500 feet of four track subway.

General News.

In St. Louis the trolley car is being pressed into ambulance service.

The new officers of the Siemens & Halske Company are Augustus W. Wright, Pres., Charles E. Yerkes, Vice-Pres., and O. W. Meysenburg, Treasurer.

It is estimated that electrical mining plants in Colorado at the present time represent an investment of over $1,000,000. Eight years ago electricity was not used in that connection in Colorado.

The annual report of the Westinghouse Electric and Manufacturing Company exhibits net earnings for the year of $802,469. Deducting from this $90,490 cost of removal of their works, left a balance of $711,910, of which $274,058 was paid in dividends, $437,852 being carried forward as a surplus.

It is said that trolley cars have been prohibited on the road from Berlin to Charlottenburg because they would pass by the Imperial Technical Institute, and experiments have shown that the current would so affect all the apparatus in the building that delicate scientific observations and experiments would be rendered impossible.

An electric hair cutter consists of an ordinary comb with a thin platinum wire running along the top of the row of teeth. A battery attached brings the wire to a white heat, which being drawn through the hair not only disposes of the superfluous portion but singes the remaining ends, which latter under the old regime cost an extra quarter.

The Government printing office will be equipped with electricity both for lighting and power purposes. In the direction of lighting alone a saving of $1,200 a month will be effected. Small motors also will be attached to the various machines so that they may be run independent of adjoining machinery, besides doing away with heavy shafting and expensive belting.

A new compass for ship use has been devised which will indicate the approach of a vessel at a distance of from four to six miles and thus give warning of possible approaching danger. The compass is connected with a very powerful magnet, which is also in connection with the ship's dynamo. The moment a ship enters the magnetic field of the vessel carrying the compass, which is calculated at about six miles, the needle is deflected. The deflection closes an electric circuit, which rings an alarm bell and gives warning of the approach of the other vessel. The magnet is prevented from affecting the ship's steering compass by a fence of narrow strips of brass around the compass.

CAR BUYERS' HELPER.

This is the name given to a publication just issued by the Brownell Car Company, of St Louis. It is a book of nearly 200 pages, printed on fine paper, illustrated with half-tone cuts, and is handsomely and substantially bound in cloth. The purpose of the work is to give buyers of street cars a concise yet comprehensive idea of all the points of excellence which constitute a first-class car. No matter how well informed any one may be on this subject, it will be impossible for him to read this careful presentation of facts without being the better for it. No street car manager can afford to slight the facts presented, and an intelligent observance of many of the suggestions made would not only be a good thing from the standpoint of the companies purchasing cars, but the public would be the gainers also by an improved service.

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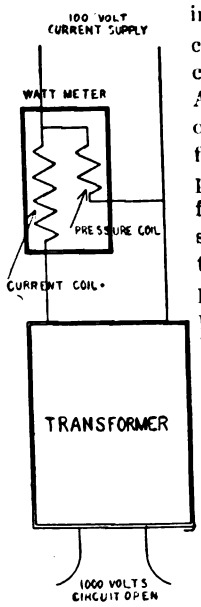
CHOICE OF TRANSFORMERS.

Economy in Selecting Best Makes—Should Be Tested Before Using—Data Based on a Series of Tests—The Cheapest Not Necessarily the Best.

PAPER BY PROF. D. C. JACKSON, MADISON, WIS.*

The public data which are available for forming an opinion of the comparative economy of transformers is very meagre. The little which is obtainable is to be found in a great measure in the advertising circulars of the manufacturers, and while these results, being tests of their own and of rival makes, are often entirely reliable, such ex-parte data are unsatisfactory to a careful purchaser. In order to place before you independent data representing all the American transformers of moderate capacities I will give the results of a long and carefully carried out series of tests made by Mr. A. H. Ford in the laboratory of the University of Wisconsin. For these tests transformers of fifteen hundred watts capacity, as nearly as possible, were procured directly from the manufacturers within about a year from this date, so that the tests may be presumed to represent the latest and best designs which are now supplied. These transformers are from the most prominent makers, and in fact include all the important makes of American transformers with two or three exceptions.



The results of the tests are given in the attached table (Table 1). These results, I find, do not differ very widely from those published by the Fort Wayne Electric Corporation in a small blue-printed pamplet which, however, contains tests made by the company upon only a few of the makes of transformers included in my table.

The data for each transformer are given for tests upon two frequencies—125 and 60 periods per second respectively. Efficiencies have been calculated and are given in the table for each transformer when operated upon each frequency continuously at full load, and also when operated at an assumed load which may be taken as an approximation to the load found on good stations operating twenty-four hours. The latter are called "all-day" efficiencies, and are calculated as though the transformers ran nineteen hours out of the twenty-four on no load and five hours on full load. A comparison of the losses of the different transformers and their efficiencies shows in most cases that the transformers with the smallest iron losses give the highest "all-day" efficiencies. The effect of the iron loss on the working efficiency depends upon the length of time the plant runs. The waste of power due to the iron loss in the transformer continues as long as current is fed to the primary circuit, consequently a plant which only runs six hours per day will only waste one quarter of the power by the iron loss of its transformer that it would if operated twenty-four hours per day. The actual number of watts hours used by the customers of the plant might not differ very greatly in the two cases, yet the out-put of the station when run twenty-four hours might be much greater than when run six; the difference being due to the difference in the amount of power wasted in the transformers. It is therefore evident that extreme care in the selection of the best transformers to be used on an alternating plant which runs all day may be of the greatest advantage. The lower the frequency of the alternating current, the more important is this testing.

The advantage to be derived by testing every transformer before placing it on the line:

Let us compare transformers Nos. three and four as given in the table. These are both made by well-known manufacturers. The copper losses at full load do not differ very much, what difference there is being in favor of No. four. At average loads there would be considerably less difference in these two points.

The iron losses, which go on regardless of the load as long as current flows in the primary winding, differ very greatly even if we take three-fifths of the loss in number four as the losses of a 1500 Watt transformer of that type.

Let us suppose that these transformers are placed on a plant which supplies current twenty-four hours each week day, and twelve hours on Sunday, which makes a total of eight thousand one hundred and thirty-six hours per year that current would flow in the primary winding of the transformers, and the total number of Watt hours wasted by the two transformers is shown below:

	f = 125	f = 60
Transformer No. 3.—	8136 X 32 = 262,000.	8136 X 46 = 374,300.
Transformer No. 4.—	8136 X 80 = 651,000.	8136 X 140 = 1,140,000.

In a station which turns out a kilowatt hour for each eight pounds of coal burned (and this in Wisconsin requires the station to be well arranged and the use of coal that costs two dollars and a half or more) transformer number four requires the buying of about a ton and a half of extra coal every year when operated at a frequency of 125; therefore it costs, other things being equal, upwards of four dollars per year more to operate than number three. It would therefore pay well if other things were equal to buy transformer number three *even if its first cost were many dollars greater than that of number four.* The difference between the transformers is even greater when the frequency is 60.

For every hundred transformers of the types here compared, the generator plant that supplies current to number four must be of five kilowatts greater capacity than that required for number three, which means an increase of three per cent. in the generating plant; that is, a plant of a given size which uses transformer number four, must have a capacity for supplying current greater by three per cent than if it used transformer number three.

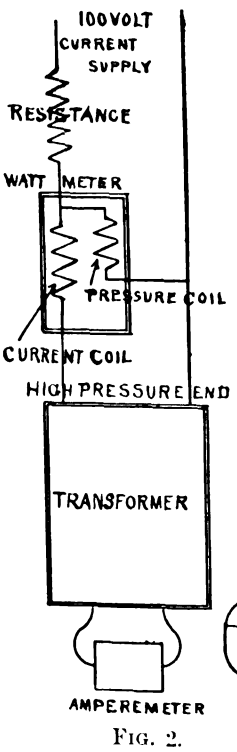


FIG. 2.

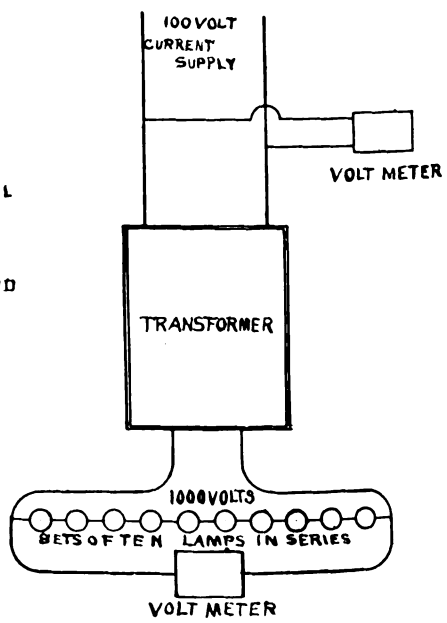


FIG. 3.

The difference between these two transformers is largely due to differences in the relative amounts and arrangement of the iron and copper in the cores and windings and the quality of the iron core. The standing of the manufacturers renders it probable that the transformers are of equal durability and reliability, but the regulating of number four is better. The regulation question, which should be carefully considered, makes a serious

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deduction from the claims of number three to first place in the comparison. Differences sometimes occur between transformers of the same size and same make which are not as great as the differences here shown to exist between numbers three and four, but are sufficiently great to make a great difference in their economy. In order to husband the capacity of a plant and to save in operating expenses, it is therefore of importance not only to test transformers of different makes which are presented for sale, but *to test each transformer which is put on the line.* This may be easily and expeditiously done. To test the iron losses the secondary coil of a transformer should be connected to the regular lighting circuits, with an ordinary watt-meter included, and the circuit of the primary coil should be left open; the arrangement is plainly shown in figure 1. The reading of the watt-meter shows the number of watts which are wasted by the iron loss.

A watt-meter such as is required for these measurements costs from forty to seventy dollars and is an instrument that, like the steam-engine indicator, pays to have at hand for proper use. However, if the regular watt-meter is too expensive to buy, an ordinary Thomson recording watt-meter if a sufficiently sensitive and reliable one is at hand, may be used in place of it, and the record taken when reduced to the basis of one hour. It is need less to say that all instruments used in such tests as are here proposed must be fairly reliable.

To test the copper losses in a transformer the quickest and easiest method, which is approximately accurate, is to connect the primary coil of the transformer in series with some resistance (iron wire or lamps) to the alternating incandescent circuit, and short-circuit the secondary coil of the transformer through an ampere-meter (Fig. 2). The resistance should be adjusted until the full load current of the transformer flows through the ampere-meter. The reading of a watt-meter so connected in circuit with the primary coil gives the copper loss approximately.

The drop in pressure in a transformer may be measured by connecting the transformer to the lighting circuits and reading the primary and secondary pressure by voltmeter (Fig. 3). The transformer may then be loaded by lamps and the pressures again read, when the drop is at once seen. One voltmeter may be used for this, but two are more convenient

For the testing of individual transformers as they are delivered and before they are put on the lines, all the instruments which are required are already in the possession of the electric stations, with the exception of a watt-meter, and this is not a serious deficiency, since, if necessary, a Thomson recording watt-meter may be used instead. The testing need take but little time and is likely to result, in average stations, in the saving of considerable waste.

Proper transformer tests enable a station manager to determine at once the amount of saving that he may make by replacing certain small transformers by one large transformer. If tests are not made such changes may not bring the results expected, since a number of first-rate small transformers may be replaced to no advantage by a large transformer if the latter is not a good one; but usually a large transformer, if one of the best, is more desirable than several small ones, whether they are good or bad.

For your guidance in selecting transformers, I will give you the following data, contained in a table made out by Professor Ryan. The table gives the largest currents which should flow in the one thousand volt primary of good transformers when the secondary circuits are open:

Watt's capacity.	Leakage current.
1,000	.055
2,000	.080
6,500	.100
17,500	.200

For intermediate capacities, intermediate values of the open circuit or leakage may be expected. I will add to this the values of the iron loss which should not be exceeded in thoroughly good transformers:

Watts capacity.	Iron loss.
1,000	30
1,500	40
2,000	50
2,500	60
4,000	80
6,500	100
17,500	150

The copper losses in transformers of all sizes should never exceed three and one-half per cent. at full load, and ought to be between one and a half and two and a half per cent. The total drop in secondary pressure due to loading a transformer, if the primary pressure is kept constant, ought not to exceed three and a half per cent.

TABLE I.

Number.	Watts Capacity.	Open Circuit Current.		Watts Iron Loss.		Watts Copper Loss. Full Load.	Total Pressure Drop.	Efficiency.			
								Full Load.		All Day.	
		f=125	f 60	f 125	f 60			f 125	f 100	f 125	f 60
1	1000	.028	.064	24.	28.	33.	3.0	95.	94.	87.	86.
2	1200	.043	.096	37.	48.	30.	2.5	95.	94.	85.	83.
3	1550	.076	.124	50.	71.	45.	3.5	95.	94.	85.	81.
4	1500	.052	.100	32.	46.	38.	4.0	96.	95.	89.	85.
5	1500	.073	.113	57.	76.	31.	2.5	94.	93.	83.	79.
6	1500	.077	.144	43.	55.	28.	3.0	95.	95.	86.	84.
7	1800	.056	.800	53.	109.	67.	5.0	94.	92.	85.	75.
8	2000	.055	.091	42.	56.	55.	5.0	95.	94.	89.	86.
9	2500	.230	.540	135.	230.	44.	2.5	92.	89.	77.	68.

* Read before Northwestern Electrical Association, July 18.

SEMI-ANNUAL CONVENTION.

The following is the programme of the convention of the Northwestern Electrical Association:

WEDNESDAY.

Morning.—Roll call at 9 a. m., followed by presidential address and report of committees. The following papers will then be read and discussed:

"Central Station Economy," by J. S. Stephens.

"Electrical Influence," by A. V. Abbott.

Afternoon.—A visit will be made to the Harrison Street Edison plant and to the power house of the Metropolitan Elevated Electric Railway, the party starting from the hotel at 2 p. m.

THURSDAY.

Morning.—The meeting will be called to order at 9 a. m., and the following papers read and discussed:

"Boiler Feed Waters and Their Treatment," by W. D. Jameson.

"Electric Street Lighting," by George Cutter.

Afternoon.—At 2 o'clock a trip in a special train will be made along the drainage canal as far as Joliet.

Evening.—The local committee has made arrangements for a theatre party to the Columbia Theatre, where the "Merry World" is on the boards.

FRIDAY.

Morning.—The following papers will be read and discussed:

"The Choice and Testing of Transformers," by Prof. D. C. Jackson.

"Boilers and Practical Specifications for Building the Same," by Jno. C. McMynn.

Afternoon—A drive will be taken through the parks..

Officers: First vice-president, George Grimm; second vice-president, Pliny Norcross; secretary, Wm. Goltz; treasurer, John Schuette. Directors, F. A. Copeland, O. M. Rau, E. M. Highlands.

Committee on Legislature.—I. P. Lord. C. D. Wyman, John Schuette and G. L. Cole.

Committee on Schedule of Rates.—Geo. A. Davis, Geo. Farwell and P. H. Korst.

Committee on Transportation.—M. J. Sullivan, W. W. Low and F. Overbagh.

Committee on Board of Underwriters.—Pliny Norcross, O. M. Rau and Wm. Goltz.

Committee on Entertainment.—S. F. B. Morse, A. C. Bunce, J. B. Wolff, John Valentine and Chas. E. Gregory.

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GOOD JOKE ON ROBISON.

General Manager of the Toledo Traction Company Nearly Put Off His Own Car.

"Jim" Robison, as he is familiarly called by his friends in Toledo, had an experience a few days ago which will make him more careful in future. He had swallowed a hasty dinner, says the "Bee," and had boarded belt line car No. 22 as it passed by Ashland avenue and Bancroft street. He was in a hurry. He wanted to get to the Casino before the "Chimes of Normandy" commenced to chime.

Manager Jim was in such a hurry that he left his bocketbook and pass book both at home. He had changed clothes. And thereby hangs a tale. If Manager Jim had been forced to hoof it down town, as he came near having to do, the tale would have been longer.

As it was, the good-natured official struck a snag as soon as he squeezed in the rear seat. The snag wore badge No. 340, and he had just been employed by Superintendent Herbert. His name is G. Christa, and he had not forgotten the positive instructions received when he took the position

"Fare, please," said he to Manager Jim. The latter was very busy talking to Congressman Ritchie, and never looked around.

"Fare, please."

"That's all right," replied James J., glancing up

"It's not all right with me. I want fare or ticket."

"New man, ain't you?"

"Yes, sir. Fare, please."

"I thought so. I am the manager of this line."

Jeems turned around to renew his conversation, when the conductor took him by the shoulder and made him face the music.

"That's too thin. I happen to know Herbert. You can't work me. You must pay your fare or get off the car." Then he reached for the bell rope.

The jaunty air of the street car official left him for a moment. His face got red; then he commenced to smile. The passengers commenced to giggle. That settled it, and Jeems reached in his pockets for his pass book.

It was not there. Then he reached for a nickel. He was shy. He appealed to the solemn-faced congressman to tell the conductor who he was, but Byron shook his head and said he did not know the man. Another passenger thought he was a dead beat, and so whispered to the waiting conductor.

Clang went the bell. The manager was about to be put off. But Mr. Stephens, the news agency man, reached over a nickel and paid the fare just in time to save his friend.

"Will you discharge him," asked the Bee man, after reaching the transfer.

"Discharge him? H—ll no," replied the manager. "That's the kind of men that make good superintendents. I will keep my eye on that chap. He will make us a good man."

Then he went into the office, got a book of passes and made a hot touch on the company safe.

AT A CINCINNATI HOTEL.

TRAVELLER—"Please change my room, Mr. Clerk, and give me one with an arc light in it."

HOTEL CLERK—"What do you want an arc light in your room for?"

TRAVELLER—"I've just been reading the morning paper and I find that the residents on Barr street say the arc light attracts bugs, and Manager Beggs of the lighting company says that it also kills them. If that is the case I figure that I can get about four hours more sleep every night."

Electricity and the bicycle may drive the noble horse to the rear, but no mechanical substitute will ever supplant the humble cow.—*Chicago Tribune.*

THAT THE DEAF MAY HEAR.

"A novel device will be introduced into the new Albaugh Theater now in course of construction on the Blaine lot in Washington," says the Washington Post. The innovation is the idea of Mr. J. E. Keelwyn, of Chicago, who also is the president of the recently organized Protective Telephone Association of America. The intention is to put in a row of chairs for deaf people. These chairs will be equipped with electrical appliances by means of which the occupants may form a very lively impression of what the performers on the stage are saying, as well as doing. The scheme is novel, and the projector is confident it will produce a tremendous sensation in the scientific world. Mr. Keelwyn is also going to put the President's mansion in telephonic communication with the stage, so that the executive and his family may at all times be in touch with the performance.

THANKS! THANKS!!

THE ELECTRICAL JOURNAL PUBLISHING COMPANY, Chicago.

GENTLEMEN—I am in receipt of a couple of copies of your valuable journal. I give it this title after a careful perusal of its columns.

If an electrical paper of such standand can be maintained, it will very soon meet with the co-operation of all electrical people.

For many years I have subscribed to the electrical journals; at present I am taking two, but being very much pleased with your publication I have concluded to stop both of those papers, and, therefore, I will ask you to continue yours.

Very truly yours,

C. F. MCBRIDE,

158 West Fifth street, St. Paul, Minn.

THE AGE OF ELECTRICITY.

We live in an electric age—
There is no doubt of that.
The world is spinning so it's hard
To know just where we're at.
Electrical discoveries
Have revolutionized
The world, till if the dead could wake
They'd be just paralyzed.

Imagine Caesar at first sight
Of an electric car!
He'd turn and run from sheer affright,
Nor look back till afar.
Imagine good George Washington
(Whom we are proud to own
The hero of his time) perplexed
Before a telephone.

Sir Isaac Newton would be dazed
To see the telegraph;
The thought of talking under seas
Would make Columbus laugh
In scorn; and old Diogenes
Would take to speedy flight,
And drop his lantern, if he saw
A big electric light.

Yet greater wonders are to come—
So wise men prophesy:
This is the age of miracles,
And, long before you die
Dame Progress you may see, perhaps,
A pair of bloomers don,
And even Philadelphia
May get a wiggle on.

—*Somerville Journal.*

Are you a subscriber to THE ELECTRICAL JOURNAL? If not, it must be evident to you that you ought to be.

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JOSEPH HENRY, LL. D.

Born at Albany, 1797. Discovered the laws of the electromagnet; the first to operate an electric motor at a distance; discovered self-induction and the oscillatory discharge of a condenser; the first secretary of the Smithsonian Institute.

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The Electrical Journal.

Vol. 1. CHICAGO, AUGUST 1, 1895. No. 5

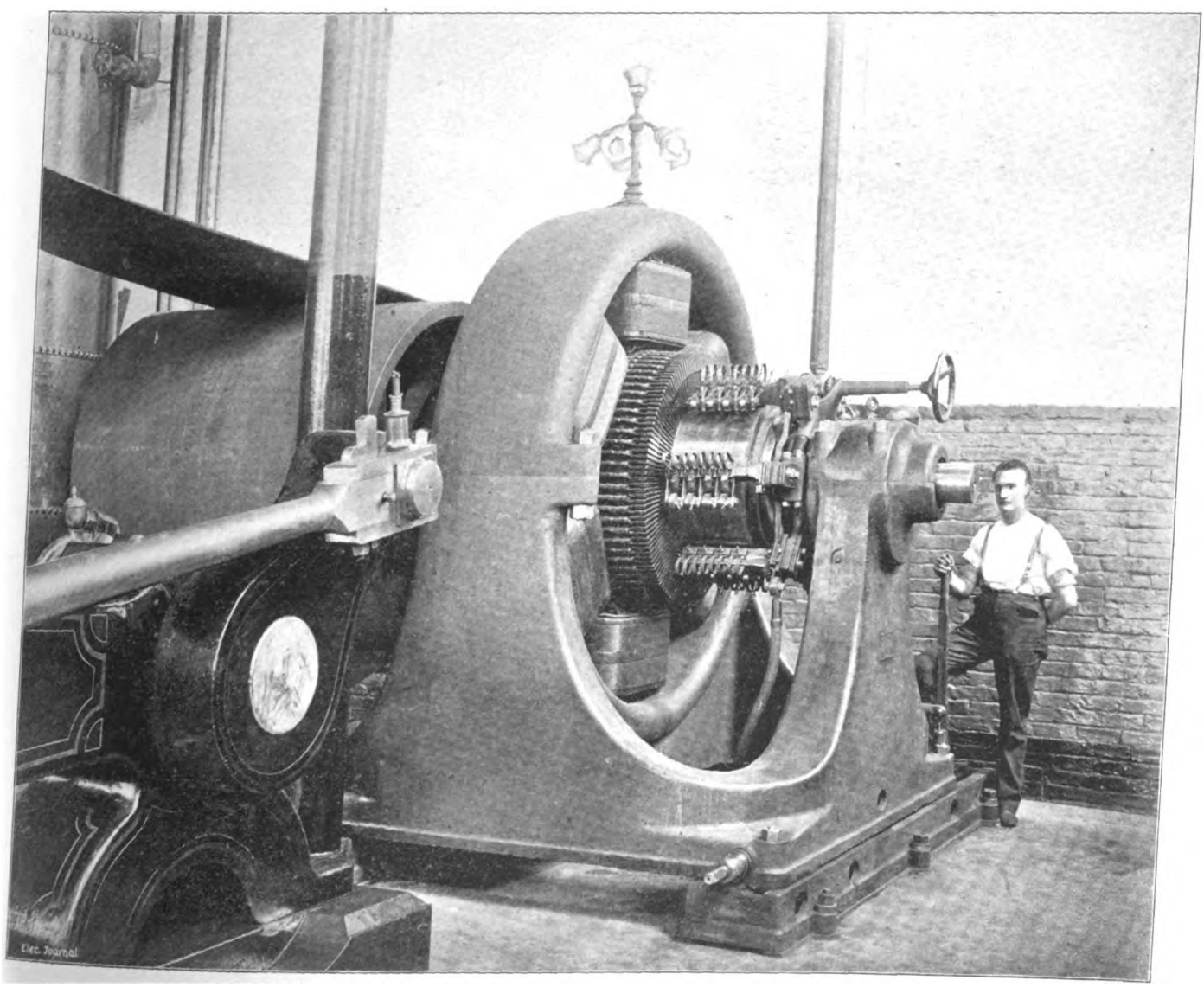
ELECTRICITY HAULS THE CABLE.

Chicago City Railway Installs a 600 H. P. Motor to do Service Formerly Performed by Steam—First Cable Plant in the Country to be so Operated.

MODEL ELECTRIC RAILWAY PLANT.

There have been so many instances recently of the substitution of electricity for steam for power purposes that any new application of it in that direction will hardly come in the nature of a surprise, and yet the installation of a 600 horse-power motor in the Fifty-second street plant of the Chicago City Railway Company is a matter of some interest for the reason that it is the first time that steam has given way to the new power for purposes of operating a great cable railroad.

The Chicago City Railway Company controls most of the street railways of the South Side, part of which consists of electric service and part of cable service. Three great cable stations and one electric station furnish the motive power. The cable plants have been operated by steam heretofore, but at the Fifty-second street station electricity will henceforth supply the power to drag the cable a distance of two and three-quarter miles and return. It is but another illustration that under favorable conditions electricity may supplant steam. In this particular instance the electric power plant of the company adjoins the



WESTINGHOUSE SIX-POLE MOTOR, 600 HORSE POWER, 500 VOLTS.

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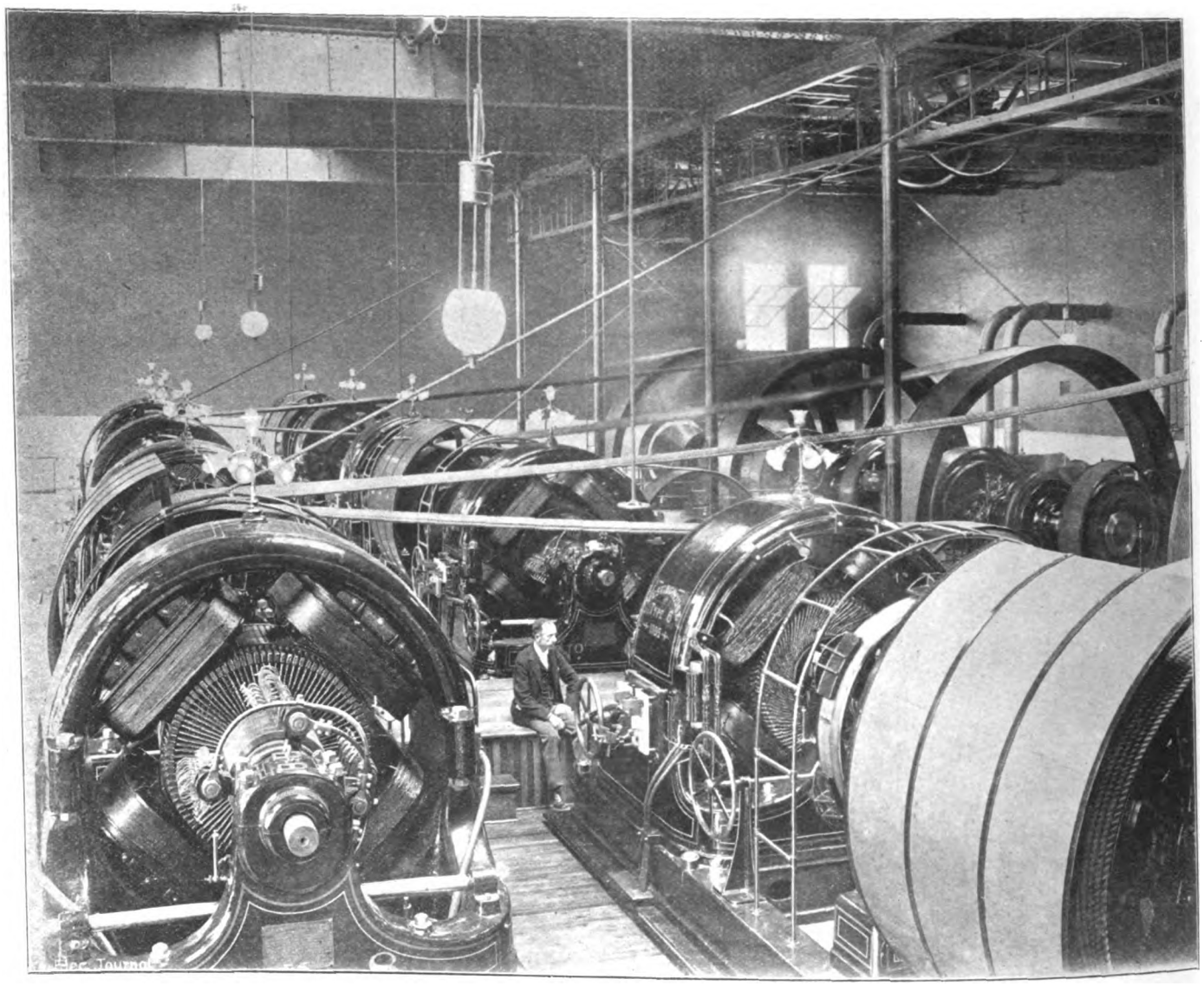
cable plant, so that it has only been necessary to carry the current across an alley to a 600 horse-power motor which has been installed in the cable plant building. This motor is of the Westinghouse multipolar type, capable of developing 600 horse-power continually at 300 revolutions per minute. It is necessary however that this speed should be varied according to requirements, so as to run anywhere from 60 revolutions up to its maximum speed and to provide for this, a water rheostat is placed in the basement immediately beneath the motor. There is a switch in connection with the motor also by means of which the direction of rotation may be reversed at will. The new motor will do the work formerly performed alternately by two 250 horse-power Wheelock engines, and will do away with the motor just installed, but because it also furnishes the current which operates nearly 100 miles of single-track electric road, and because it is one of the best equipped electric power-plants in the country. The current was first turned on at this station May 13th, 1893. At that time the plant consisted of 4 engines, 4 generators, and 7 boilers. To-day there are 10 engines, 10 generators, and 14 boilers.

The boilers are horizontal tubular, 72 inches in diameter and 20 feet long, with Murphy patent furnace. Two Shafer & Bodenberg exhaust injectors are in use for feeding the boilers, with a Worthington Duplex pump in reserve. The two feed water heaters are of the Baragwanath type. All the steam connections between boilers and engines are made of copper.



GENERAL VIEW OF DYNAMO AND ENGINE ROOM.

entire steam plant in the building. One of the engines has been dismantled and is now being removed, the other will remain in position and will be connected with the steam plant of the electric power-house so that in the event of any accident to the new motor the service can continue by simply turning on the steam through the connecting pipe. The motor is connected directly by a 48 inch belt to the main pulley of the driving machinery. This main pulley is 24 feet in diameter and is at a distance of 60 feet from the motor. About 250 horse-power is the average load necessary to operate the cable after it gets started, but in order to get it moving each morning it will require very close to the full capacity of the motor.

In this connection the adjoining electric power-house becomes interesting, not only as the source of supply for the new

The 10 engines are of the Green-Wheelock pattern, connected in pairs, the cylinders are 24 inches in diameter with a 48 inch stroke, and are run single expansion; the fly wheels are 18 feet in diameter, weigh 30 tons each, and make 100 revolutions per minute.

The generators are 10 in number, are Westinghouse multipolar, and capable of developing 700 horse-power each. They are driven by rope 1¼ inches in diameter after the Hoadly compound system, and make 300 revolutions per minute.

The switchboard consists of one main panel, 10 generator panels and 40 feeder panels. The main panel is fitted with a Westinghouse voltmeter and Weston ammeter, with a capacity of 10,000 amperes, and indicates the total output of the station at any time. On each generator panel is a lightning

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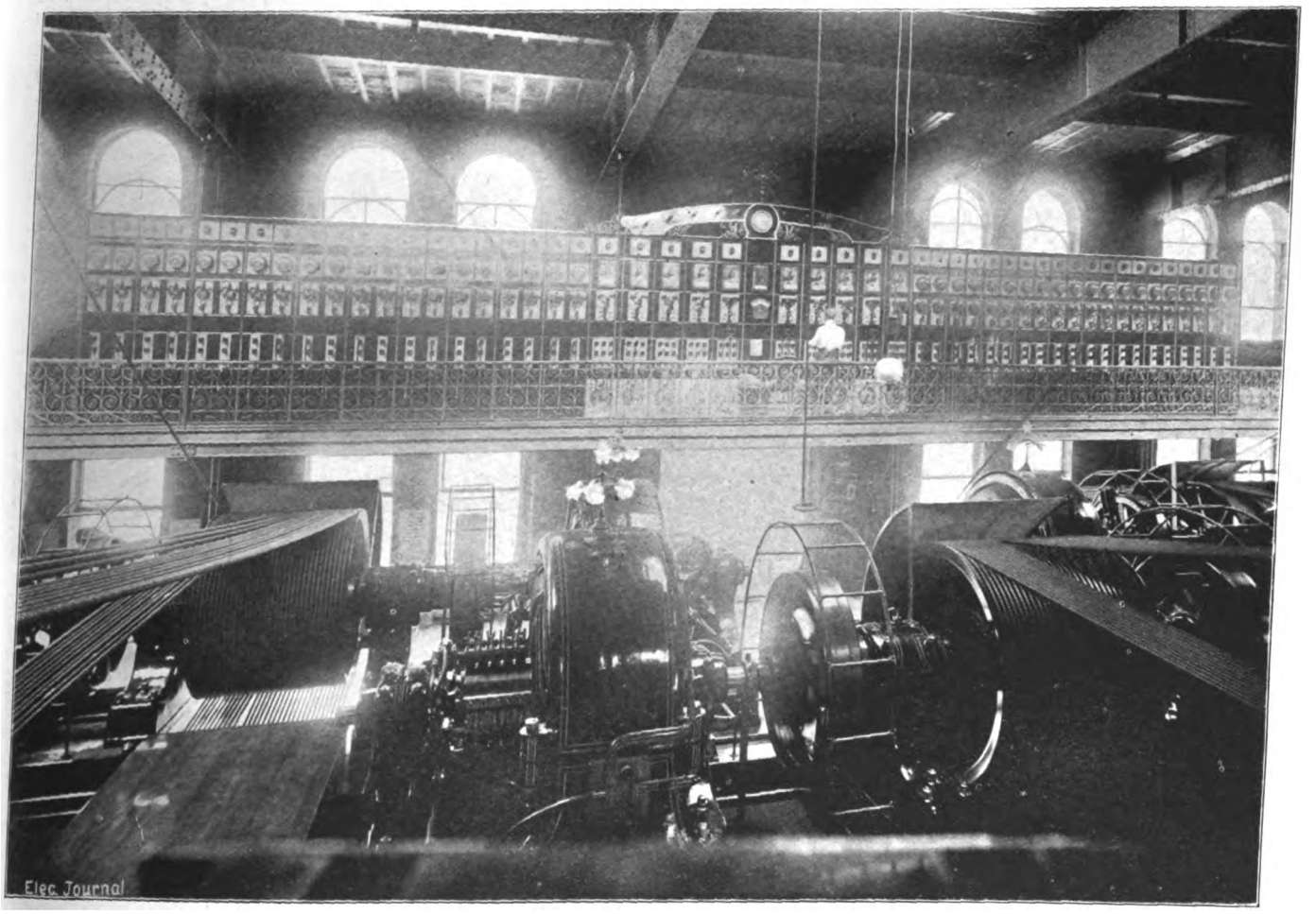
arrester, ammeter, triple-circuit breaker, triple-pole switch, voltmeter, plug-receptacle and rheostat. The 40 feeder panels have each a lightning arrester, Weston shunt ammeter, automatic circuit breaker and single pole switch, each panel having a capacity of 1000 amperes.

In the basement of the building are 10 Wirt tank lightning arresters, one being connected with each generator, and are put in service only during a storm.

The building in which the plant is contained is a structure 125 x 150 feet facing on Wabash avenue. It is 30 feet high and has a brick smoke stack that towers 175 feet in the air. The whole plant is a model of compactness, neatness and efficiency, and is the special pride of Engineer Riley who keeps it looking like a new pin all the time.



CHICAGO CITY RAILWAY POWER HOUSE SWITCHBOARD, 10,000 AMPERES CAPACITY.

ELECTRICITY FOR MAINTAINING HEAT.

The Carnegie Steel Company at Homestead is experimenting upon a new plan of keeping molten metal in condition after it is drawn from the furnace into the ladle. The experiment consists in forcing a current of electricity into the steel.

In steel mills considerable trouble is caused and often loss sustained by the metal chilling in the ladle before it can be poured into the moulds. The Carnegies began the experiment with electricity last night in the open hearth department. The result was in a measure satisfactory, although a number of workmen were slightly burned by the intense heat resulting from the contact of the electricity with the hot metal. When the current was introduced the molten steel was set to bubbling, and the light and heat were phenomenal. The workmen, not expecting that effect, had neglected to wear heavy colored glasses, and a number of them are now suffering with very sore eyes.

The experiment will be continued, and if successful will save the company a great deal of time and money.

USES OF ELECTRIC OZONE.

There seems to be no end to the uses to which electrically produced ozone can be put. Its application to the maturing of wines, spirits, tobacco and coffee, to bleaching, and to a great number of electro-therapeutic conditions, is already a familiar story, but a new use has now been found for it in the maturing of the sounding-boards of pianos. The value of the pianos of the most eminent makers is greatly dependent on the employment throughout the instrument of well-matured wood, and the sounding-board especially must be of wood so ripe and well-seasoned that its lasting qualities can be assured. It is not surprising, therefore, that a large proportion of the capital of the great piano manufacturers is swallowed up in the maintenance of extensive timber yards, in which their stock of wood has to be allowed to reach the desired age and condition. It is said that ozone will produce on wood in a short time all the changes which it is usual to rely on age to accomplish, and piano manufacturers have taken up the matter in the hope of being able to greatly curtail a serious item of their standing expenses. In linoleum factories, too, where the thickening of linseed oil was brought about by allowing it to trickle over strips of gauze for several months, the use of ozone now effects the purpose in a few days. In another new process ozone converts crude potato starch into the soluble variety (a very important operation to the distiller), as well as into dextrine and other gummy substances.

Dr. Froehlich, the German scientist, believes he is on the verge of another triumph for electricity in the production of nitric acid from the air by means of ozone.

IN BROOKLYN.

TEACHER—What is the chief end of man?

BRIGHT PUPIL—Trolley accidents mostly.—*Judge.*

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ELECTRICITY AT THE BEDSIDE.

Clinical Course at the Cook County Hospital — Melancholia, Epilepsy, Chorea and other Diseases of the Nervous System.

LECTURE BY PROFESSOR D. R. BROWER.

LADIES AND GENTLEMEN: The task of discussing with you the therapeutic applications of electricity in nervous diseases has fallen to my lot, and we will to-night introduce the subject by talking about the technique of these applications in diseases of the brain.

The first question that will arise, and a question that has been extensively discussed, is whether or not it is possible to send a galvanic current through the brain. Of course it may be possible to send a galvanic current through, when it is not possible to send a faradic current, and not very long ago, at a meeting of the Pan-American Congress at Washington, one of the distinguished teachers of therapeutics made the positive declaration that it was impossible to send a galvanic current through the brain; that when the electrodes of the battery were placed in the usual position—that is, one on the forehead and the other on the nape of the neck—the current simply traveled around the skull, and the effects observed were simply those of the current upon the nerves of the scalp: that is, purely reflex. If this is the case, then all this apparatus which we have here is absurd. We can get reflex effects without any such complications as this battery furnishes. The reasons given by this gentleman for his statement are that the current follows the line of least resistance, and this line is around the scalp.

I believe that the galvanic current does go through the brain, not around it, and I believe it takes this direction because it is the line of least resistance. The scalp is a very poor conductor of electricity. The blood supply of the scalp is the same as that of the skull. Blood is a saline fluid, and a most excellent conductor of electricity, and when you apply the sponges in the method of longitudinal or transverse galvanization, the current follows these blood vessels to the dura mater. Then you have the cerebro-spinal fluid, a most excellent conductor of electricity, so that the line of least resistance is through the brain.

Now what are the effects that are produced by this longitudinal galvanization? The intelligent patient will tell you that he first experiences a sense of coldness in the head. What does this mean? A disturbance of the brain—the vaso motor effect, not through the fifth or pneumogastric nerve, but the direct effect upon the blood vessels. Secondly, the patient will tell you that he experiences a peculiar taste, and pretty soon he observes flashes of light. This, I take it, is the effect of the current upon the optic sense, the sense of sight, and when you consider this vaso motor disturbance, when you consider the effect upon the taste, and the effect upon the optic centre, and when you consider that this is the line of least resistance and not, as Dr. Hare says, "around the scalp," I think we may start out fully impressed with the idea that the galvanic current does go through the brain.

Now we use this current in three different ways for the purpose of getting the effect of the current on the brain. This is the positive or anodal electrode, and this is the negative. Now we have here a rheostat, and the milliamperemeter is in the circuit also. We will send through the brain a current (we have two milliamperes of current) by this longitudinal method of galvanization, and that is a pretty fair current for ordinary cases. I think you will get better effects from the weak currents, although there are some cases in which a very much stronger current may seem necessary. The duration of this treatment will, of course, vary with the case. Five minutes is a very ordinary time of treatment in my experience, but sometimes very much longer treatments are necessary. In the transverse galvanization you want just about the same current strength. Now we have about one and a half milliamperes in the circuit. We also sometimes desire to have simple localized effects, and then we will place one pole in some indifferent place and secure the localized effect as desired. Suppose we are trying to improve, if possible, the nutrition of the third frontal convolution on the left side: we will place the other electrode upon that part of the brain that we propose to benefit. A very great deal has been written in times past about the direction of this current, and in my early experience with electricity I used to be very particular about this "polar dictum" business. I don't think now that it is of as much importance as I once supposed. The change in the direction of the current I do not think amounts to as much as I once did, and in giving the ordinary longitudinal treatment of the brain, it is my practice to put the positive electrode in front, because the patient will stand a current of higher amperage with less discomfort, and you will find you can send a current of very much higher amperage through the brain if the positive pole is in front. (Now let us have that case of melancholia.)

In considering this question of the use of electricity, I desire to state at the beginning that electricity is simply an aid to treatment—an aid to proper internal treatment. I don't of course, pretend to treat any kind of nervous disease by electricity alone, but I regard electricity as possessing two very important properties, and if I were called upon, I would say it is alterative and tonic, and it combines the properties of mercury and iron. It modifies nutrition in the part; there is no question about its power of stimulating the lymphatics, there is no question about its power to produce absorption; it produces absorption by its stimulating effect upon the lymphatics. I have just got through with a case in which there was a large amount of inflammatory deposits around the wrist joint. With frequent applications of electricity, after a few months' treatment, we brought about the absorption of almost the entire inflammatory deposit in that wrist and hand. Stimulating absorption in some similar way as that produced by potassium, mercury, etc., regarding the remedy as alterative and tonic it seems to me it has an important place, especially in the treatment of the more chronic affections of the nervous system, and the first of these affections to which I ask your attention is insanity.

We have on this bed now a case of melancholia. You know very well a case of melancholia, in its earlier stages, when it makes complaint, will tell you about many disagreeable sensations in the head, about an occipital pain, and about disturbances of sight, sound and smell, and cases of melancholia, as you well know, have a very feeble circulation, and in most cases the temperature is below the normal.

The sluggish condition of the lymphatics creates, in my opinion, a demand for tonics. I should want to know that the patient had an abundance of properly prepared and easily digested food, and I would see to it that the patient had proper tonics and alteratives, and if you will add to this such internal treatment, such as each case would indicate in the mind of a careful, observing physician, I am sure you will find, as I have, in the earlier cases of melancholia—and it is your business to recognize them early—you will secure most admirable results, as I am going to show you. In treating these cases, it is wise to use the galvanic current and the static. Don't consider that instrument (an eighteen inch, four plate machine,) that you see there, as the static machine I would use: that is a mere toy, a mere model and amounts to nothing. A static machine that is not four or five times as big as that, would not produce any of the effects I think static electricity is capable of producing.

In the administration of galvanic electricity, we use long-

Lecture delivered as part of the Electro therapeutic Course of the National School of Electricity

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itudinal galvanization of the brain, and we might repeat for the benefit of those coming in late, that this patient is a little bit uncertain, but we will do the best we can. You want a low amperage, one to two at most, and the seance ought to be five minutes. She has a very feeble circulation—the feeble pulse that belongs to these unfortunate cases. A current of from one to one and-a-half milliamperes will not be at all disagreeable. We have one-half there now. In using this longitudinal galvanization of the brain, you want to be extremely cautious in turning on your current, and just as carefull in turning it off. Shocks are very bad things, for I believe they are going right through the brain, and you cannot afford to give shocks. We have got now one milliampere of current. That ought to be permitted to pass for at least five minutes. That is the first step in the treatment of cases of melancholia, in my opinion, by galvanization. Another important thing to do is to pass this current through the cervical sympathetic, and thereby you improve the vaso-motor tonus. The cervical sympathetic, as you know, is one of the regulating mechanisms of brain circulation; the superior cervical, as you know, presiding over the positive brain circulation, and if you send this galvanic current through the cervical sympathetic, I believe you improve the vaso-motor tonus of the brain. To take the second step we will throw the current off gradually; we had one milliampere on and we will gradually throw it off. We have the positive now at the neck and we will apply this to the cervical sympathetic and we want about the same amperage. We will place this electrode along the inner border of the mastoid muscle, using the negative, and we want the more stimulating current in order to bring to bear the effect of the current upon this part of the nervous system, and here about two milliamperes of current at least are required. There—we have it now. We want to move this up now without removing it; you don't remove the the electrode and produce a shock, but you move it up and down and thereby bring to bear the current upon this part of the nervous system, then throw the current off and apply it in the same way on the other side. Now this galvanization of the cervical sympathetic, I believe, improves the tonus of the brain, and these are the two steps in the use of electricity in this form of insanity, psychosis, and what is true of this form is also true of climacteric. In addition to the use of galvanism in these cases of melancholia, I use also the static charge, and I am well satisfied in my own mind that the declarations made by Prof. Morton are correct, from my observation, that it promotes elimination, especially of carbonic acid and urea. You put a patient on an insulated stool with a current of high voltage, and it will bring the pulse up or down, as the case may be, that is, it will equalize it. If the circulation is rapid, it will decrease it: if it is too slow, it will increase its rapidity, and then it will bring sub-normal temperature up: it won't bring fever temperature down, but it will bring abnormal temperature down: it will produce elimination, and it does modify the temperature. I don't suppose a machine like this would do it, but you take a machine that will throw a 12-inch or 18-inch spark, where the voltage is high, and it will produce this effect, and that is what you want in these cases. Elimination is defective, temperature is low, and is usually sub-normal.

The first thing to do with these patients is to insulate them, and we will have this patient on the insulating stool: now we will charge her with electricity through this negative jar. I don't think it matters very much whether you use the positive or the negative, any more than I think it is very material as to which direction the current passes through the brain. In addition to other apparatus, I have in my office this coronet that we use instead of grounding, then we connect it with the coronet, and the current passes out by the coronet rather than to ground. This static insulation is very soothing as well as a modifier of circulation, and a promoter of elimination.

There is one other way in which we use this static electricity in the treatment of cases of melancholia, and that is by sparks. We take off sparks from the spine, and for that purpose we ought to have a sharp pointed electrode, very much like the lightning-rod, and we connect it with one of the cords, regulating the sparks. The machine I am in the habit of using makes a spark of about a foot. The kind of a spark we drew a moment ago is just the kind that we are now getting off her back. A general stimulus is through the cord. So much for the technique of the treatment of this psychosis, climacteric insanity, etc. In cases of melancholia, the ordinary climacteric, and the lacteal insanities, I believe you will get very good results.

The next one of these brain diseases to which I ask your attention is that of paralysis. What we have already said in regard to the treatment of melancholia, pertains to the treatment of paralysis. No physician who has good judgment in the matter will rely entirely upon electricity. It is simply to be used in hemi-plegia as in cases of psychosis—as an adjunct. We have here a case of paralysis of the brain, I don't remember anything about the history, but so far as the treatment at this stage is concerned it is a matter of no consequence. We wish now, in cases like this, to modify and improve the brain circulation for the purpose, as far as possible, of promoting absorption. Moreover, what I think we most need in these cases of hemiplegia is to so improve the circulation that we may build up centers to take the place of those that have been cut off. In the treatment of these cases of brain paralysis, we use galvanism just precisely as we did before, but we not only use the longitudinal galvanization, but the transverse, and we want the same amperage or a little bit more than in the cases of melancholia. We will put, as before, the negative electrode behind, and the positive electrode in front. This is a very favorable case. Paralyzed about two months ago. We will take the longitudinal galvanization, as before, and we will give him a couple of milliamperes of current, (put it on gradually) we have three on now,—that is a little bit more than we need—two and-a-half to three milliamperes of current thrown on gradually with the rheostat, and thrown off in the same way. The current should pass in this longitudinal direction about five minutes, and in this treatment there is also some advantage in giving the transverse galvanization, throwing on the current as before, and giving about the same intensity. Now in addition to this galvanization of the brain by these two methods in the treatment of paralysis of brain origin, we must pay attention to the paralyzed members. The muscles of these paralyzed arms ought to respond to the faradic current. You can use a very mild galvanic current after the period of inflammatory action had disappeared, that is in most cases, anywhere from four to eight weeks. After that has passed, which is about eight weeks at a maximum, then I think it wise to begin with mild currents, but up to that time I don't think it is. I think there is danger then by reason of the effect of this current on the circulation, so I should wait until after the inflammatory period is passed.

Now let's get at this arm. There is, in this case, not much muscular atrophy—there may be some, and what is here ought simply be atrophy of disuse. There is not anything like the wasting of the deltoid muscle. The lesion could not have been a very extensive one as the paralysis has in a great measure recovered. The deltoid muscle is usually much wasted. You see the reflex is here that belongs to paralysis of brain origin. These muscles require not only electricity but massage, and I should begin the massage long before I began the electricity. I believe in the very early use of massage; especially I believe in efforts directed to the preserving of the deltoid muscle, and I think this treatment should be commenced within a week or ten days after the attack. This electrode can be placed anywhere that is convenient. (We want the faradic current now, you understand.) We want a current of low intensity. These muscles usually respond best to the secondary currents. We now have the secondary current: we go over these muscles with a mild current, and we want a moderate response, and I do not think it is wise to make a muscle contract much, or more than three times. I am sorry to say that a great many physicians in these cases, and in other cases of paralysis, send the patient off to buy a battery and tell him to go and take a shock, and I find the patient takes the thing and rubs it up and down, and I have

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patients come to me often who say they have one of these batteries, something like that for a static machine, and the treatment consists of rubbing the brush over the muscles. The intelligent members of this class know that such treatment is an absurdity. What we want to do is to pick out the various muscles and make them contract. It is muscular exercise you are after, and you want but a few contractions, and it must be done with the mildest current that will produce the result, so you take these muscles, one after the other, and make them perform their characteristic movements, and that is treatment that is of some consequence. So in these cases of cerebral paralysis the technique would be first the galvanic current in the way I have indicated, and then keep up the nutrition. The muscles in this man's case are already beginning to show the atrophy of disuse and, of course, there is a difference in the arms. The early beginning of electricity prevents the progress of atrophy, and pretty soon you will find these muscles beginning to grow, and you will keep the muscles in good condition, and in some cases it is possible to make new paths out from the impulse to the cortex, or what I believe is possible, to perform these functions in new areas—but be that as it may—should the brain resume its functions, you will have a basis upon which the brain can operate, and what is true of the arm is also true of the leg, of course, and so it is also true of the muscles concerned in speech. I think it is important to begin, as soon as possible, with the muscles concerned in speech. So much for the technique of treatment in these cases of cerebral paralysis. (Now you can push yourself off to one side).

The next is epilepsy. In epilepsy we need something that is alterative. Unless we can prevent it by alteratives, a change takes place. In galvanism you have an agent that certainly will, by its influence, tend to prevent this degeneration of the brain structure, and I am quite sure that judicious use of the galvanic current with large electrodes and high amperage—I am in the habit of treating epilepsy with a high amperage current—is beneficial. I think the advantage is in high amperage currents and I use very large electrodes; I use the thin Hay's abdominal electrode, which covers the whole head as a skull cap, and then I use a current of about ten milliamperes.

Now there is another of these brain diseases in which electricity has been of service in my hands, and that is chorea. We have not a chorea patient here to show you, but you are all familiar with them. I give arsenic in gradually increasing doses, and then add to that the current by insulation by a static machine of high amperage. The violent patients are the ones who fall into my net, and it is quite pleasant to see these very violent chorea patients on the insulation stool stop their movements, and just so long as we keep them on the insulating stool they stop. If static electricity has anything like the effect that Morton and others claim for it, if it has the power of elimination, equalizing the circulation, then it must be of benefit in chorea, and it is, and I should not like to treat these severe cases without the use of static electricity of very high voltage.

In ordinary cerebral neurasthenia, I am in the habit of using static electricity. We use electricity by insulation, putting the coronet on the head and connecting it with Leyden jars and also by the use of galvanic electricity I think you get better results than if you rely simply upon internal medication. Sometimes you will get good results in these cases by brain and spinal cord galvanization. I have seen some good results follow in cases of neurasthenia by what I would call general galvanization, and I will show you what I understand by general galvanization. Is is of considerable service in forms of cerebral neurasthenia. We will take the patient as far as we can, and will show you how I think this general galvanization should be used in the treatment of these cases of cerebral neurasthenia. The first step in the operation is simply ordinary longitudinal galvanization, which we have already shown you—a current of low amperage. The second step in this case of cerebro spinal neurasthenia is the one we showed you a moment ago, the galvanization of the cerebro-spinal centers. Send through the brain a current of about two or three milliamperes, then through the cerebro-spinal from four to five milliampers, depending upon the sensitiveness of the patient. That is the second step in the use of galvanization in the treatment of cerebro-spinal neurasthenia. The third step is the galvanization of the spine. Some of my skeptical friends say we cannot pass a current through the spine, but we want the negative over the epigastrium, and the positive over the spine. We will gradually pass this electrode without removing it—gradually down the spine, and we want a current for this purpose of from five to ten milliamperes, depending upon the sensitiveness of the patient. This application through the brain would take five minutes, through the cerebro-spinal two and-a-half minutes, and through the spine two and-a-half minutes more, making ten minutes in all. The current must be passed down the spine to the lumbar region and then back. There are some cases that do better with general galvanization than with the static current of high voltage, so we frequently use it. I much prefer the static, but when they don't improve with the static, I use general galvanization. Our time has expired; an hour is as long as it is well to discuss these things, but I did intend to say a word or two about the treatment of hemicrania, but I think we will let this go until next Friday. I thank you for your attention.

ELECTRICITY IN AGRICULTURE.

By experiments made in France it has been demonstrated that electricity may be made a valuable aid to agriculture. Just what the exact chemical action is, has not been satisfactorily determined, but the fact remains that both fruit and vegetables, at least certain varieties, grow and ripen with astonishing rapidity where the current is applied to the earth in which they are.

Electrical machines are of course too expensive for farmers' general use under present conditions, but the value of the current in this connection being established, it will stimulate inventive genius to devise some means of furnishing it.

An invention called a geomagnetifere has already been used for this purpose; it consists of an ordinary pole forty or fifty feet high, surmounted with a cheval-de-frise of copper spikes, designed to act as a collector of atmospheric electricity. This collector is insulated from the pole by a porcelain knob, and connects with a copper wire (also insulated from the pole), which transmits the current to a network of wires which are laid under the soil at a depth of about six feet. These wires are made of galvanized iron, and their cost is not large.

By the use of this apparatus the production of a given area has been increased 50 per cent. The grapes from vineyards in which the geomagnetifere is used are richer in sugar and alcohol than ordinary grapes. Flowers have a stronger perfume also when stimulated in this manner.

The experiment can be tried on any lawn or flower bed so long as the pole is away from the house. If too close it acts as a lightning conductor, but without giving any protection.

It is estimated that a geomagnetifere sixty feet high will enrich the soil to the same degree as ten times its cost in manure. At the present time a successful farmer has to be something of a chemist, and it now seems as though he will have to be an electrician, also.

The car horse gave a gusty sigh,
And watched the trolley skim
Along the dusty avenue,
A block or more from him.
He said: "I hope before I die
The happy day will dawn
When I can go to grass and say
My occupation's gone."—*Washington Times*

When lovely woman stoops to folly,
She stumbles prone upon the dust;
But getting backward off the trolley
Car's less common now, we trust.

—*Street Railway Review.*

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NORTHWESTERN ELECTRICAL CONVENTION,

Successful Session Held—Business Interspersed with Pleasure—Next Meeting in Milwaukee.

The third midsummer meeting of the Northwestern Electrical Association, held in Chicago July 17 to 19, has now passed into history but its memory will for a long time be green to those who were in attendance. Viewed from any standpoint the meeting was a success, though there were not as many present as might have been hoped for. What it lacked in numbers, however, was made up for in interest. The usual routine of business was transacted; several papers on important subjects were read, and topics in which the general trade is concerned were discussed to the benefit of all who were present. The convention, however, was not arranged for business and for sober discussion alone; the members only get together once in every six months, and they very properly feel that a portion of the time can be very profitably set apart for the cultivation of that spirit of good-fellowship without which work would become mere drudgery, and even life itself would be robbed of one of its most delightful phases; so the convention day was divided up into three parts, the morning for business, the afternoon for pleasure and the evening for more pleasure.

The committee on entertainment consisted of five past masters in that line, Messrs. Morse, Bunce, Valentine and Gregory. They arranged a visit to the splendidly equipped powerhouse of the Metropolitan Elevated Railroad and to the Edison Lighting Station; they made up a coaching party and drove along the boulevards and through the parks; they took their guests to the "Merry World" performance at the Columbia Theater, and they wound up by "doing" the drainage canal: where else they went on pleasure bent, "deponent sayeth not," but the general verdict was that the committee had performed its duty in an entirely satisfactory manner. Not during the entire three days of the session, it is said, was any member heard to give expression to that historic complaint made by the Governor of North Carolina to the Governor of South Carolina, nor was anything else left undone that ought to have been done.

AN AFTERNOON AT THE DRAINAGE CANAL.
A Group of Northwestern Electrical Association Members.

The next convention will be held in Milwaukee in January. Somebody suggested that Milwaukee be reserved for a summer meeting place, but the original motion carried.

The new officers and committees of the Association are: President, George Grimm; First Vice-Pres., Pliny Norcross; Second Vice-Pres., P. H. Korst. Committee on entertainment, Messrs. Andrea, Row and Smith. Transportation committee, T. R. Mercein, together with the president and secretary. Committee to secure papers to be read at the next meeting, Fred. De Land, J. S. Stephens and W. H. Thorp, together with the president and secretary. The selection of officers gave very general satisfaction.

ANOTHER RAILROAD FALLS IN LINE.

The Northern Pacific Railway is the latest convert to electricity among the great lines running out of Chicago. First the Illinois Central arranged to adopt the new power for its suburban traffic, then the Northwestern line made arrangements in the same direction, and now it is the Northern Pacific. General Manager Samuel P. Ainslie, in an interview a few days ago said:

"I do not wish to discuss the matter just now. I will say, however, that it is true we were granted an ordinance by the township of Cicero to operate our trains under a new system."

"When do you expect to make the change?" he was asked.

"Within four months."

"Will the change apply only to your suburban trains or to the whole line?"

"We expect to equip our entire service with the new power," said Mr Ainslie.

"Have you received figures on your proposed plant, or have the contracts for its constructiou been signed?"

"No, no contracts have been entered into, but I would rather say no more about the matter at present."

And thus electricity is gaining a foothold among the great railway systems of the West. It is possibly not too much to expect that in the near future the entire suburban branches of the many great trunk lines will be operated by electrieity, when if it proves the success that is anticipated for it, it will extend to the long distance service.

A medical newspaper says that the trolley has saved more lives than it has sacrificed by giving the people, especially to invalids, both cheap and rapid locomotion with plenty of fresh air. But do not tell the trolley line syndicates. They will raise the fare and demand subsidies for building new lines.
Chicago Chronicle.

OH, FOR A COMMISSIO LUNATICO INQUIRENDO!

Dr. P. J. Gibbons, of Syracuse, who believes that electrocution does not electrocute, has recently announced that he has proven to his own satisfaction that electricity is "cold instead of warm." He is firmly convinced that the prevailing belief that electricity is composed of heat and light is wrong, and further that electricity is really cold, and is capable, therefore, of producing cold. Dr. Gibbons says he was led to this belief as a result of several reasons. In the first place, he had always thought it strange if electricity was composed of heat and light that it was more apparent on a cold day than on a warm one. He was aware, he says, that on a cold day one could light gas by rubbing one's feet along a carpet and then bringing a finger in conjunction with the gas jet, while on a warm day this could not be done. He believes that in the near future electricity will be gotten into a liquid state, and in that state will be used to produce cold, but whether this takes place or not, it can be used for the same purpose in its present state. This theory, he claims, "has never been advanced before, much less demonstrated, as I have done."
—*An Exchange.*

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ELECTRICAL EQUIPMENT RULES.

Detailed Explanation of the Regulations Imposed by the City of Chicago and the Board of Fire Underwriters.

OF INTEREST TO ELECTRICAL CONSTRUCTORS.

This series of papers is not intended for the instruction of experts. Its object is to show to those who are unacquainted with the laws of electricity, the reason for and the philosophy of these rules and regulations. They will be taken seriatim, and thoroughly dissected in language which will be perfectly intelligible to the youngest student. C. C. HASKINS.

CONTINUED.

HIGH POTENTIAL SYSTEMS.

Any circuit attached to any machine, or combination of machines, which develops over 300 volts difference of potential between any two wires, shall be considered as a high potential circuit and coming under this class, unless an *approved* transforming device is used, which cuts the difference of potential down to less than 300 volts.

OVER 300 VOLTS.

10. OUTSIDE CONDUCTORS. All outside, overhead conductors:—

a. Must be covered with some insulating material, not easily abraded, firmly secured to properly insulated and substantially built supports, all tie wires having an insulation equal to that of the conductors they confine.

b. Must be so placed that moisture cannot form a cross connection between them, not less than a foot apart, and not in contact with any substance other than their insulating supports.

The tie wire, it is understood, is the fastening wire which secures the line to the insulating device. In order to make this attachment secure the tie wire is drawn so tight as occasionally to cut through the insulator of the line wire, and thus afford opportunities for a leak, if a bare tie wire is used. The use of an insulated tie wire is therefore demanded, as being less liable to do harm.

c. Must be at least seven feet above the highest point of flat roofs and at least one foot above the ridge of pitched roofs over which they pass or to which they are attached.

In the smoke and excitement attending a conflagration, it is all important that buildings should be clear of everything that may endanger the safety of the firemen and others whose duty requires their presence on roofs. A very small wire might trip and throw a man off of a roof, under such circumstances, especially in a night fire.

d. Must be protected by *dead insulated guard irons* or *wires* from possibility of contact with other conducting wires or substances to which current may leak. Special precautions of this kind must be taken where sharp angles occur or where any wires might possibly come in contact with electric light or power wires.

The constant vibrations of wires and of buildings to which they are attached are incessant in their wearing effect. The insulation of the best wire made will readily wear through if only allowed to rest lightly on an iron gutter, the corner of a wall, or the stay rod of a boiler stack. From each of the above causes we have had trouble through the grounding of electric light wires.

e. Must be provided with petticoat insulators of glass or porcelain. Porcelain knobs or cleats and rubber hooks will not be approved.

A petticoat insulator is one in which there are two or more deep channels between the outside of the insulator and the pin which supports it. The general shape is perhaps described by saying that it is two inverted cups, one inside the other, completely joined in one at the top. The object of this arrangement is a more complete break between moisture and the line. Porcelain knobs have an iron screw connecting them to the wood, and moisture readily creeps on to this screw and thus makes a leak from line to ground. Cleats do not hold the line far enough away, and rubber hooks, because of the sulphur used in vulcanizing them, become coated with sulphurous acid, the sulphur combining with the oxygen of the atmosphere, to produce that result. Sulphurous, as well as sulphuric acid, is quite a good conductor.

f. Must be so spliced or joined as to be both mechanically and electrically secure without solder. The joints must then be soldered, to insure preservation, and covered with an insulation equal to that on the conductors.

All joints must be soldered, even if made with the McIntyre or any other patent splicing device. This rule applies to joints and splices in all classes of wiring covered by these rules.

The making of a joint, as simple as it would seem, is by no means readily learned. First, it is necessary to make several turns of the brightened ends around each other—for strength, and for contact. Second, it is necessary to thoroughly cover the parts so in contact with flowing solder—to more intimately connect them, and prevent moisture from breaking up the mechanical contact by corroding the touching portions. The joint should be well covered with insulating compound and then wrapped with pure rubber tape, extending at least three-quarters of an inch either way from the bare copper. The compound and the rubber will keep out the moisture. Now, for mechanical protection, a wrapping of friction tape is put on outside all.

g. Telegraph, telephone and similar wires must not be placed on the same cross-arm with electric light or power wires.

The class of wires mentioned do not require, and never have as high insulation as electric light wires, and are usually grounded. Crossing one of these with a lighting or power circuit would probably work mischief. They are to be kept away from dangerous familiarity.

11. SERVICE BLOCKS:—

a. Must be covered over their entire surface with at least two coats of waterproof paint.

To prevent the absorption of moisture and consequent lowering of the insulation.

12. ALL INTERIOR CONDUCTORS (Including services):—

a. Must be covered where they enter buildings from outside terminal insulators to and through the walls, with extra waterproof insulation, and must have drip loops outside. The hole through which the conductor passes must be bushed with waterproof and non-combustible insulating tube, slanting upward toward the inside. The tube must be sealed with tape, thoroughly painted, and securing the tube to the wire.

Insulation is again the object. Tubing entering from the outside slants downward so that water will run off outside the building. The "drip loop" is a bend in the wire (for the same purpose) where it enters the tube.

b. Must be arranged to enter and leave the building through a double contact service switch, which will effectually close the main circuit and disconnect the interior wires when it is turned "off." The switch must be so constructed that it shall be automatic in its action, not stopping between points when started, and prevent an arc between the points under all circumstances; it must indicate on inspection whether the current be "on" or "off," and be mounted in a non-combustible case, and kept free from moisture, and easy of access to police or firemen. So-called "snap switches" shall not be used on high potential circuits.

In case of fire or other trouble it is often necessary to completely cut off the building, and a switch for that purpose is required. It should be automatic, because otherwise, if it stopped at an intermediate point between "on" and "off," an arc might cause trouble. Moisture is to be avoided for reasons given above. A snap switch is not intended for high potential circuits, because the amount of break is not sufficient—the opening is not wide enough to prevent the arc reaching across. A proper switch for this purpose on being thrown, closes the contact on the second point, before opening the first. In other words, the break is not abrupt, but gradual.

c. Must be always in plain sight, and never encased, except when *required* by the inspector.

It is not safe to conceal conductors of this class, except they are placed in metallic sheathing or tubes.

d. Must have an *approved* insulating covering.

Insulation that will be approved for interior conductors must be solid, at least three sixty-fourths of an inch in thickness and covered with a substantial braid. It must not readily carry fire, must show an insulation resistance of more than 100 megohms per mile after 100 days' immersion in solutions of lime, sulphuric acid, ammonia, subway refuse, or such other chemical compounds or mixtures, and at such temperature as it will be liable to be subjected to in service, and must stand a breakdown test with an alternating cur-

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rent, having a pressure fifty per cent. in excess of the normal current to be operated through the conductors.

In making such tests the braid will not be considered as any part of the insulation.

SOLUTIONS IN WHICH INSULATED WIRES ARE TO BE SOAKED.

First solution, ten per cent. sulphuric acid.
Second solution, ten per cent. ammonia.
Third solution, saturated solution lime.
Fourth solution, subway refuse dissolved in Chicago hydrant water.
Fifth solution, Chicago hydrant water.

The most important and vital point in electric light work is insulation.

MOTOR CARRIAGE CONTEST.

Award Will Be Based on General Utility, Speed, Cost, Economy of Operation and Design.

Interest in the motor carriage contest, which will take place November 2, between Milwaukee and Chicago, is developing rapidly as the weeks go by, and there is every indication that by Sept. 15, the date upon which the entries close, there will be a much larger number of prospective competitors than had even been hoped for when the substantial prizes were first held out as an inducement for some special effort in this direction. It is reported that leading carriage builders all over the country have turned their attention to the devising of vehicles for this purpose, and the result is sure to be something of a practical character. Following are the rules which will govern the contest:

RULES.

1. The date of the contest will be on Saturday, Nov. 2, 1895. The judges may postpone the contest if in their judgment the state of the weather or the condition of the roads will not permit a fair trial.

2. The contestants will start at some point in or near the City of Milwaukee and will finish at some point in or near Chicago, not farther south than the south limit of Lincoln Park.

3. The contest is limited to automatic carriages, or, as they are more commonly known, "horseless carriages." There will be eligible to competition any and all vehicles having three or more running wheels, and which derive all their motive power from within themselves. No vehicle shall be admitted to competition which depends in any way upon muscular exertion, except for purposes of guidance. Competing vehicles which derive their power from petroleum, gasoline, electricity or steam, and which are provided with receptacles for storing or holding the same, will be permitted to replenish the same at Waukegan, Ill., and at Kenosha, Wis., but at no other points.

4. No vehicle shall be admitted to competition unless it shall comfortably carry not less that two persons for the entire distance, one of whom may have charge of the vehicle and the manipulation of the same.

5. No vehicle shall be admitted to competition except that it shall be free from danger, not only to its occupants but to spectators and the public users of the highway. The judges, at their discretion, may debar any vehicle which from its construction gives evidence of defects which would render the adoption of its type an evident impossibility.

6. For the purpose of limiting the contest to vehicles of practical utility a preliminary test of all vehicles entered for competition shall be held by the judges on or about Saturday, Oct. 26, under such rules as the judges may determine on, and for such a distance as they may decide. At this test the judges may debar such constructions as in their opinion do not possess features entitling them to further consideration. It is stipulated, however, that all motor vehicles which won prizes or honorable mention in the Paris-Rouen contest of 1894, or in the recent race between Paris and Bordeaux, shall not be compelled to compete in the preliminary test, but shall be admitted upon proper application to the final competition on Nov. 2.

7. In making awards the judges will carefully consider the various points of excellence as displayed by the respective vehicles, and so far as possible select as prize winners those constructions which combine in the highest degree the following features and requisites, rating them of value in the order named:

A. General utility, ease of control and adaptability to the various forms of work which may be demanded of a vehicle motor. In other words, the construction which is in every way the most practical.

B. Speed.

C. Cost, which includes the original expense of the motor, and its connecting mechanism, and the probable annual item of repairs.

D. Economy of operation, in which shall be taken into consideration the average cost per mile of the power required at the various speeds which may be developed.

E. General appearance and excellence of design. While it is desired that competing vehicles present as neat and elegant an appearance as possible, it should be assumed that any skilled carriage-maker can surround a practical motor with a beautiful and even luxurious frame.

8. All vehicles must be entered for competition not later than Sept. 15, 1895. All applications should be addressed "Editor Horseless Carriage Contest, Room 511 Times-Herald Building."

The date of the contest will not be changed from Saturday, Nov. 2, except for extremely bad weather or condition of the roads.

In answer to many inquiries as to how the carriages will be started it may be assumed that the judges will start them one or two at a time, keeping accurate record of the exact time each carriage passes the starting point, the same as is the rule in a yacht race. The various vehicles will be designated by numbers conspicuously displayed and a record will be kept of the time at which they pass various points along the road. Other less important rules will be formulated and officially announced by the judges at the proper time.

While two persons are fixed as the minimum number of passengers carried, the judges will undoubtedly take into consideration the handicap imposed on vehicles conveying a greater number.

DANGER FROM LIGHTNING.

Figures Show Decreased Liability to Accident in Thickly Settled Communities.

A report for the five years covering 1890-1894, issued by the weather bureau, shows that 1,120 lives were lost by lightning in the United States, an average of 224 per year. The months of June and July show the maximum death rate. In the five years from 1885 to 1890 also there were 2,220 fires caused by lightning, aggregating a loss of $8,386,826. In 1891 the loss was $1,355,525 for 457 fires; in 1892, $2,921,484 for 839, and in 1893, $1,645,180 for 659. The years 1892 and 1894 were very disastrous both to life and property. The report goes on to point out that there is much greater danger from lightning in the country than in thickly settled districts, a fact attributed to the numerous iron pipes, tin roofs, cornices, chimnies, steeples and various other avenues furnished by the latter providing escape into the ground. It also points to the fact that standing under trees in the country during a storm is particularly hazardous and especially under oak trees. If 1 represents the frequency of being struck for the beech tree and 15 for pines, other trees average about 40 and the oak 54.

LET HER COME.

"The motor wagon's comin',
I hear it on the curve,
'Tis movin' every muscle
And strainin' every nerve;
Get on board, children,
Get on board, children,
For there's room for many a more."

Exchange.

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ECONOMICAL HEATING OF CARS.

Electrical Heaters Compare Favorably in Point of Efficiency, But Cost More Than Coal Stoves—A Maximum of Heat Wanted at a Minimum Expense.

SUMMARIZED STATEMENT OF EXPERIENCES.

It would be naturally supposed that the heating effect of an electric current such as is used in street railway service, could be utilized for the heating of cars during the cold months of the winter in a form that would be both efficient and economical; this seems not to be the case if judgment is based on the experience of companies which have made experiments along this line. Of course it is no criterion that because practical results have not been obtained thus far, some inventive genius will not rise to the necessities of the case and at some time in the future provide an application of the electric current for this most servicable end which shall be in all respects just what is needed, but yet the fact remains that for the present at least electric heaters are either not effective or else that they are so much more expensive than coal burners that their use is precluded by companies which study the points of efficiency and economy both, as most of them do.

Mr. M. K. Bowen, Superintendent of the Chicago City Railway Company was one of those who wanted to give his patrons the best that was obtainable, and last winter he conducted a series of experiments with a view to determining whether the electrical current could be used for heating cars, but that his experience was not satisfactory may be gathered from the following report of results:

TESTS ON HEATING CARS, CHICAGO CITY RAILWAY.

During last severe winter 76 motor cars with Anthracite coal stoves of magazine or self feeding pattern, and 10 motor cars with 2 types of electric heaters, were operated. Cars 21 feet long with no vestibule. Back and front doors opened occasionally in actual service. Tests were made for heating cars to 35° F. above outside temperature.

Hard coal delivered to barns cost $5.35 per ton. Stove consumed 1½ pounds per hour.

Coal delivered at power station at $1.40 per ton.

Electric heaters consumed 6.2 amperes.

	ELECTRIC HEATERS	HARD COAL STOVE
Estimated interest at 6 per cent. electric heaters at $50. and stoves at $25.	.0082	.0041
Estimated depreciation 10 per cent. electric heaters and 20 per cent. stoves.	.0137	.0137
Repairs and care.	.0020	.0067
Cost power or fuel consumption.	.9360	.0803
Total cost per car per day of 18 hours.	.9599	.1048

The stoves used by the Chicago City Railway Company and those referred to in the above test are manufactured by the McGuire Manufacturing Company of Chicago. They are hard coal Magazine heaters designed to be placed in cars without disturbing or cutting the seats. The heater sets in a chair the feet of which rest upon the floor and the back fastened to back of seat, holding the stove above the seat but not resting upon it.

Mr. Bowen, it seems, was not altogether satisfied to let the matter rest there. He wanted to know what others' experience had been, and so addressed the following letter about a month ago to a number of the leading street railway managers of the country:

Dear Sir:

As we wish to place our order immediately would ask that you give me the benefit of your experience as to the best method of heating cars, the make of electric heaters or stoves that you use and the first cost of equipment and cost of fuel per car per day for stoves or electric heaters.

In return for your kindness, for which allow me to thank you in advance, I will be glad to give you the benefit of our experience and tests in the matter during the last winter should you desire it, as well as a synopsis of answers to several inquiries we are making.

The replies, of which a synopsis is here given, would seem to indicate that there are yet some improvements to be made in electric heating as applied to street car service before it can come into general use.

DATA ON HEATING STREET CARS.

Atchison, Kans.,	Tried 2 kinds Electric heaters, will adopt one.
Atlantic City, N. J.,	Trying Electric heaters. Cost unknown.
Aurora, Ills.,	Electric heaters. Satisfactory, but more expensive than stoves.
Bath, Me.,	Electric heaters. Cost 4 times as much as stoves, passengers 4 times as comfortable.
Battle Creek, Mich.,	Electric heaters all right. Will take 8 to 12 amperes to operate.
Boston, Mass., (1)	Stoves. During season burned 2 tons hard coal each.
Boston, Mass., (2)	Electric heaters. Satisfactory. 7 amperes per car.
Brooklyn, N. Y., (1)	Electric heaters cost 15c for 12 hours, coal stoves cost 8c.
Brooklyn, N. Y., (2)	Coal stoves account economy.
Brantford, Can.,	H. C. stoves. Cars always comfortable. Winters severe.
Camden, N. J.,	H. C. stoves.
Chicago, Ills.,	H. C. stoves. Fuel per car per day 0616c. per season $9.76.
Cairo, Ills.,	Coke stoves. Operation per car per day (15 hours) 9½c at $3.60 per ton.
Cedar Rapids, Ia.,	Experimented with 3 different types Electric heaters. Abandoned all. With zero weather could not tell that cars were being heated. 12 foot car bodies. Now use coal stoves.
Cincinnati, O.,	Electric heaters, own make.
Cleveland, O.,	Electric heaters, clean. Have used 2 kinds.
Cumberland, Md.,	Anthracite coal stoves. Entirely satisfactory.
Danville, Ills.,	H. C. stoves. Most satisfactory. During season consume 1 8 10 tons.
Davenport, Ills.,	H. C. stoves. 15c per day. Few Electric heaters 5 to 6 amperes each.
Dayton, O.,	Electric heaters per car 5½ to 6¼ amperes. Electric heaters clean and safer.
Denver, Colo.,	Coal stoves. 10c per car per day (18 hours). Electric heaters too expensive.
Detroit, Mich.,	Cost Electric heaters prohibitory. Takes 80 per cent. as much power as to run cars. During blizzard, when needing all in power house for cars, heaters run full capacity.
Edgewater, Ills.,	Electric heaters, 6 to 7 amperes per car. Clean and easy to control.
Fredonia, N. Y.,	Tried Electric heaters. Use anthracite coal in stoves at $4.00 per ton.
Fishkill, N. Y.,	H. C. stoves. Fuel $4.25 per ton. Costs 8c per car per day.
Gardner, Mass.,	Magazine or base burner stoves. Keep fire all night. Cost 7c per car per day (24 hours). Stove we use is an ornament to a car.
Girardville, Pa.,	H. C. stoves with radiator. Cheap and entirely satisfactory.
Great Falls, Mont.,	Electric heaters account nominal expense as current is generated by water power.
Green Bay, Wis.,	An accurate account kept of fuel for H. C. magazine or base-burner stoves for 180 days, severe winter, 3c per car per day. Have tried and abandoned Electric heaters.
Hamilton, Ont., (1)	Experimented with Electric heaters and found they cost 3 times as much as stoves.
Hamilton, Ont., (2)	Electric heaters satisfactory. 8 to 12 amperes to run.
Hamilton, O.,	H. C. stoves. Cost 12 to 15 cents per day. Electric heaters cannot compare.
Hornellsville, N. Y.,	Electric heaters. Consume from 3½ to 13 amperes.
Hutchison, Kan.,	Stoves. Satisfactory.
Jackson, Mich.,	Tried Electric heaters. Use stoves. Heat better and less expensive.
Jersey City, N. J.,	H. C. stoves. 5 times cheaper than 3 kinds of Electric heaters we tried.
Kankakee, Ills., (1)	H. C. stoves. Cheaper and heat better than 2 kinds Electric heaters we tried.
Kankakee, Ills., (2)	H.C. stoves satisfactory. Cost 10c per car per day for fuel.
Kansas City, Mo., (1)	Prefer Electric heaters. More satisfactory as to cleanliness and convenience.
Kansas City, Mo., (2)	Test of Electric heaters showed 6 amperes for 22 foot car, 17° F. above outside temperature. Would cost $40 per season. We bought stoves and made them clear in one season.
Lawrence, Mass.,	We are gradually putting in Electric heaters.
Logansport, Ind.,	Electric heaters require 7 to 8 amperes. Would not use stoves.
Louisville, Ky.,	Tried Electric heaters. Too expensive. Adopted H. C. stoves. 11 8-10 cents per day.
Lynn, Mass.,	H. C. stoves. More economical as it requires 8½ amperes to heat car 40° above outside temperature.
Manistee, Mich.,	Coal stoves. Rent current.
Mansfield, O.,	Have tested Electric heaters. Too expensive. 7 amperes per car.
Milwaukee, Wis.,	H. C. stoves. Fuel $4.50 per ton. 8c per car per day. Visible heating conduces to the comfort of passengers.

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Minneapolis, Minn.,	H. C. stoves. Satisfactory. Tried Electric heaters. Too expensive.
Montreal, Can., (1)	Coal stoves. Cost 15c per car for fuel and labor. Experimented with Electric heaters. Cost of fuel 7oc per car.
Montreal, Can., (2)	Coal stoves. Better suited to our demands.
Muncie, Ind.,	Tried 3 kinds of Electric heaters. Abandoned and are making our own.
New York City,	H. C. stoves. Fuel 10¼c per car per day.
Negaunee, Mich.,	H. C. stoves. Better and cheaper.
New Britain, Conn.,	H. C. stoves. No economy in Electric heaters.
Niagara Falls,	Current maximum 14 amperes.
N. Tonawanda, N. Y.,	Electric heaters. Faulty in construction but do their work well.
Olean, N. Y.,	Have tried Electric heater. Adopted hard coal stoves. Fuel 9c per car per day.
Ottumwa, Iowa,	Electric heaters. No test for fuel consumption made.
Oshkosh, Wis.,	Coal stoves. Fuel 10c per car per day.
Peoria, Ills.,	H. C. stoves. Fuel 8¾c per day (18 hours).
Pittsburg, Pa., (1)	H. C. stoves. More economical than Electric he ters. Stoves all expense 15c per car per day in use.
Pittsburg, Pa., (2)	H. C. stoves. 1st place, economical. Electric heaters cleaner. 5 amperes.
Pittsburg, Pa., (3)	Electric heaters. 4 amperes.
Pittsburg, Pa., (4)	Nothing more practicable than coal stoves. Electricity cost 5 times as much.
Point Pleasant, N. J.,	H. C. stoves. Cheaper in first cost and operation. More economical than Electric heaters.
Quincy, Ills.,	All electric cars should be heated electrically. Neater, cheaper fuel, etc.
Racine, Wis.,	Electric heaters too expensive. H. C. stoves used for economy.
Rockford, Ills.,	Prefer H. C. stoves for small lines and Electric heaters for heavily loaded cars.
Richmond, Ind.,	Tested Electric heaters. Too costly for maintenance and power.
Rutland, Vt.,	Tried Electric heaters. 8 amperes. Selected H. C. stoves. Fuel 5½ tons at $5.00 for 165 days per car.
Rutherford, Vt.,	H. C. stoves. 15c per car per day covers all expenses when in use.
St. Paul, Minn.,	H. C. stoves. Find it difficult to heat even small cars properly with Electric heaters.
St. Joseph, Mich.,	Tried and returned 4 kinds Electric heaters. 5th kind satisfactory.
St. Louis, Mo., (1)	H. C. stoves. Satisfactory in large 40 seat cars.
St. Louis, Mo., (2)	H. C. stoves. 52 stoves and 100 tons coal at $6.40 per ton.
St. Louis, Mo., (3)	Making tests of Electric heaters, own make.
St. Louis, Mo., (4)	Coal stoves. Cost 10c per day.
Sioux City, Ia.,	H. C. stoves. Total expense 20c per car per day.
So. Chicago, Ills.,	Electric heaters. 9 to 16 amperes or 6c per hour.
Toledo, O.,	H. C. stoves.
Toronto, Can.,	Started with Electric heaters. Took out after first season. Now use stoves. Economical, satisfactory.
Utica, N. Y.,	Will test Electric heaters.
Vincennes, Ind.,	H. C. stoves. Even heat. Economical and satisfactory.
Washington, D. C.,	H. C. stoves. 1½ tons at $1 50 per ton per car per season.
Williamsville, N. Y.,	H. C. stoves. Fuel $2 per car per month at $5.20 per ton.
Youngstown, O.,	Electric heaters and stoves. Stoves most economical.

THOSE AWFUL TELEGRAMS.

"What is it, Mamie?"

"It's a boy, mum, with a telegraft."

"A telegram! Oh, ask him if James is killed!"

"He says he doesn't know, mum."

"Ask him what he does know about it."

"He says all he knows about it is that its marked 'collect,' and he wants his money."

"Oh, dear! Oh, dear! What shall I do? Here, Mamie, here's the purse. Pay him, pay him whatever he asks. Oh, my poor James! I just knew something would happen to him before he went away this morning. Will they bring him home in an ambulance, Mamie?"

"I s'pose so, mum. Maybe you'd better read the telegraft."

"I can't, I can't. Oh, it serves me right for not kissing him three times when he left. And we've been married such a short time, too!"

"Why don't you open the telegraft, mum?"

"Well, I suppose I must, but oh, I can't tell you how I dread it."

Reads the telegram: "Will bring friend home to dinner. James."

"The heartless beast!"—*New York Journal.*

ELECTROLYSIS ON MORTAR.

An interesting case, illustrating a new source of danger from electric wires, was recently brought to the notice of the Boston Board of Fire Underwriters by the accidental sounding of an automatic fire alarm at the Pray building, 658 Washington street.

For some time past a slight smoke has been noticed issuing from the casing about the electric light wires in the basement, where they enter from the street.

When the insurance inspectors arrived and the casing was removed it was found that a peculiar substance had accumulated about the wires, which, when moistened and struck with any hard substance, would give off flashes of fire. All around this point the woodwork was covered with a thick liquid, which had dried in places to a white substance resembling discolored salt, and which was slippery to the touch and strongly corrosive. The wood itself was soft and badly discolored.

As this case was thought to be of considerable importance, the matter was placed in the hands of Messrs. Forbes & Glidden, electrical and chemical engineers, who immediately began an investigation. The deposit discovered about the wires proved upon analysis, to be mainly metallic sodium.

Metallic sodium is a substance very difficult to obtain except by the aid of the electric current. It is exceedingly combustible, and unites so readily with water that its presence in a damp cellar would be impossible under ordinary conditions. When it unites with water hydrogen gas is given off, and at the same time a considerable amount of heat is generated. Under certain conditions this heat would be sufficient to ignite the hydrogen gas. Hydrogen gas and air will form an explosive mixture. Hence the greatest danger lies in the liability of an explosion if the gas should become ignited.

The explanation of the appearance in a damp cellar of a substance so combustible and unstable in the presence of moisture and metallic sodium is given as follows:

The metallic sodium was undoubtedly the product of an electrolytic decomposition of impure sodium hydrate. This sodium hydrate came from the cement mortar used in laying the brick wall of the basement, upon which the wires were supported. Some of the hydrate may have possibly worked its way through the wall from the cement used in the foundation of the paved street (Washington street) immediately adjacent.

The electric current which caused the electrolytic action was due to a leak inside the casing from one of the mains to another. The leak was produced by the action of the sodium hydrate on the insulating covering of the wires. This covering was what is known as "weatherproof insulation," which consists of a cotton braiding covered with tar. Such a material is readily attacked by sodium hydrate and its insulating properties destroyed. Moreover, the sodium hydrate itself furnishes a good path for the current when it has once penetrated through the insulation.

The case is especially interesting in connection with several of the explosions which have occurred in underground conduits, usually attributed to a leak in the gas mains. In the London papers recently it has been suggested that metallic sodium may possibly have had something to do with these explosions. This, however, appears to be the first instance in which the appearance of metallic sodium has been proved and a complete explanation of an actual case given. *Boston Herald.*

THE RAILWAY IN CALIFORNIA.

A marked era of prosperity is anticipated in California as a result of the use of electricity for railway purposes. Steam railroads have been expensive to build on the slope, and by reason of the high price of coal they have been expensive to operate, necessitating in consequence high freight rates. Electric roads being much less expensive to build and the supply of water in the mountains being abundant for power purposes, it will be practical to build, equip and operate electric roads both for passenger and freight purposes on a basis which will insure a much more extended service traversing the constantly increasing area of accessible fruit lands besides opening up great stores of lumber and fire wood in the mountains.

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

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Higher Voltage.

The application of electric traction on a large scale and for heavy work, draws attention to the most obvious method of decreasing the size of the feed wires. The requirements of surface roads even in large cities necessitate the stringing of heavy feeders, which cost enormous sums of money and disfigure the streets. The item of copper on the elevated roads, which are now certain to increase in number, is a very serious one. Coupled with these applications is the inauguration of the equipment of short laterals and feeders by the rail-roads for electric traction. Probably no distinct evolution has ever before been accomplished with such celerity as the replacement of the horse by the electric motor. We have just now entered upon the second stage in this great industrial revolution. Hence the unusual attention directed to the trial of the great electric locomotive in the Baltimore tunnel.

It becomes at this stage a live question whether the experience of the past few years has been sufficiently varied and extensive to warrant the assumption that we have settled the practicable limit of voltage to be employed with safety and success in railway traction. Why should the order of nature or the exigencies of practice have settled the limit at 500 volts? It is a pertinent question whether 1000 volts cannot be used with even greater success. It is well to say that the only gain would be the reduction of the current for any given service to one-half, with the attendant reduction of the copper, according to commonly accepted practice, to one-quarter. But this is surely an advantage which requires a good many drawbacks to counterbalance.

It may not be amiss to draw the attention of the conservative to two other analogous expansions in other fields of electrical practice. The makers of arc lighting machinery halted at forty or fifty-light machines for several years. A limit of from 2000 to 3000 volts appeared to be set for them, beyond which they must not go. It is needless to say that this limit has entirely disappeared, and machines are now running on regular service up to, and even beyond, 6000 volts. This change has been brought about by the economies demanded in large city installations. An incidental gain, in addition to the saving in line construction, and in the number of machines installed is the rise in commercial efficiency up to as much as 87 per cent. In the older small machines a commercial efficiency, 75 to 80 per cent., was all that could be expected.

Another advance has already begun in incandescent lighting. I refer to the introduction of the 200 or 220 volt lamp, on direct current circuits. The impelling reason for this change, is of course the saving of copper. This modification of practice can be accomplished only in the face of grave difficulties. The most serious one is the adaptation of the incandescent lamp to this voltage. But this appears to be in a fair way of accomplishment. Incidentally better insulation must be used, and a new line of fixtures must be developed. The old adage is likely to prove true here as in so many other cases—necessity is the mother of invention.

It is obvious that several objections can be urged against the doubling of the electromotive force in railway work. There is the increased danger to life. This objection does not appear to be an important one, since 500 volts have proved fatal in some cases, and 1000 will be only somewhat more dangerous in case of an accident. The difficulties in the way of effective insulation at the controller, and in the motor, will be enhanced, but these difficulties are by no means insurmountable. They will entail more expense in construction, but not enough to be a serious offset to the saving in copper. The change in voltage would put an additional strain upon the designers of the generators in order to secure satisfactory compounding; but thus far in the experience of American designers they have risen to every occasion requiring skill and the introduction of new features. So silently and so swiftly are these advances made, that the only record of them is often brief descriptions in electrical journals, and even these appear only after the devices are in full and successful operation.

In view of the facts set forth, would it not be the part of wisdom, for electrical engineers and the makers of heavy railway apparatus to give serious attention to this subject before any further steps have been taken in supplanting the steam locomotive by the electric motor?

Henry D. Barrett

* * *

Motor Carriages.

In another column, we publish the rules laid down by the Chicago Times-Herald to govern the motor carriage contest to be held next November.

These rules are in entire accord with our own view of what the conditions ought to be, excepting that we believe "speed" is given too prominent a consideration, and is placed too high up as a deciding factor.

In proposing and patronizing this contest, Mr. Kohlsaat must assuredly have been actuated by a desire to help to solution a question that has been forging to the front slowly for a number of years, and if he believed the question of motor carriages of sufficient importance to justify his patronage, and that of his great newspaper, he must have had in mind the utility of such vehicles in the sober business of life. If we accept this view, then the question of speed takes a very low place among the good qualities of road carriages. In the first place, in ordinary service, speed beyond eight or ten miles an hour is not called for, and in cities is forbidden by law. If the judges selected for this particular contest lay great stress on speed, then there is hardly a probability that electricity will win the prize money. But we do not believe that such will be the case, and in any event, the cash prizes offered by Mr. Kohlsaat, as generous as they are, would not justify trial for them if there were not vastly larger stakes at issue.

The carriage that wins the contest before the public, and the one that will be accorded that prize, public favor and public patronage, will be that best adapted to commercial ser-

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vice:—that which shall be most durable, and most efficient, most economical as to first cost and subsequent repairs, that which shall be always ready for service, require the least attention on a journey; and the pleasure phase will not be inconsiderable.

If these qualities shall prevail, and they certainly will in the long run, then there is no reason why the friends of electricity should fear a contest. It is true that both petroleum and steam had the best of electricity in Paris, but we believe that for many reasons these motive powers are not destined to become popular or commercial. In the first place—taking petroleum, which won the race—oil is growing more costly every day, and there is hardly a question that it is becoming scarcer and will eventually be too costly for fuel purposes. In the next place it is always accompanied by a vile odor which people will not put up with if it can be avoided, and it requires certain attentions which are disagreeable. Whatever can be said of oil, may be also said of gasoline. Steam carries with it heat and sometimes gas or smoke that almost forbids its use, even if it did not require constant attention.

It seems then that in all particulars excepting cost and speed, electricity is best. The cost will be reduced as we learn more about accumulator work, and speed will be increased as we learn to accumulate more energy into less compass, even if greater than our present maximum speed were desirable.

The one question now uppermost is current, and we all know that there is hardly a stopping place that will not furnish facilities for charging batteries, and when it becomes necessary, one will be able to purchase a charge for one's carriage just as now one may buy a bag of oats for one's horse.

Taken all in all, we do not fear to predict that the coming motor carriage contest, in its broad and far-reaching bearing, is not a trial for supremacy between various forms of motive power, but it is in reality a test between the various makes of electric carriages.

There is only one feature of the "Times Herald" plans that we do not take kindly to, and that is the adoption of the name "Motocycle." It is undignified and misleading. It is true that the wheels are cycles, but why not then call it a tricycle or a quadricycle? We do not see the necessity of bringing the bicycle into contrast here, or of placing a handicap on the new carriage by associating with it something of which some people at least have had a surfeit. We do not object at all to the bicycle, but we do object to calling the motor carriage a "cycle" of any sort.

* * *

Trolley Investigations.

In Chicago and elsewhere there is considerable talk at the present time about having grand juries investigate the question of trolley car accidents. We believe such an investigation would be a good thing, and that the street car companies would not offer any serious objection or suffer materially from the final finding. In looking into the matter it will doubtless come to light that a very considerable number of accidents occur, and it will even be made clear that some of these are due to culpable negligence or wanton carlessness on the part of the company's employes. But on the other hand it will also be found that much of the blame attributed to the companies is in reality due to the recklessness, stupidity or misfortune of the people who get hurt; and perhaps there is no better way of arriving at the true condition of affairs than by submitting the whole question to an intelligent body of unbiased men. A jury of such men would find many things to be considered in an investigation apart from the bare fact of accidents and their cause. They would, among other things, take into account the necessity and demand for rapid transit and the conditions which surround city life; then it would be a question whether under given conditions the loss of life was such as to warrant the interference of the strong hand of the law.

People who live in large cities or who have occasion to traverse crowded thoroughfares must not expect that same immunity from accidents that they would have if they lived, say on a farm; as well might they demand that invigorating, wholesome atmosphere in the city that they could enjoy in the country. Residence in crowded cities imposes certain obligations, and one of these is an exercise of greater care than is necessary in less populous districts; and if that care is not exercised, then the blame rests largely with those who suffer through their lack of such observance. The streets of cities are not places where people may wander about aimlessly and without their wits about them, nor are they safe play-grounds for children, neither can the business of a city be hampered in order that they be made so. This may be unfortunate for the children who by force of circumstances are born and brought up in a city, but there seems to be no help for it.

It is not the desire of THE ELECTRICAL JOURNAL to be understood as offering any palliation for criminal carelessness in the operation of street cars; on the contrary, every such instance should be thoroughly investigated and proper punishment meted out to those to whom the blame may attach, but there is reason in all things, and a proper exercise of it in the matter of locating the blame for street car accidents would not be amiss. Let the grand juries proceed with their investigations and let us arrive, if possible, at a better understanding about the relations which ought properly to exist between the public and the railway companies.

* * *

Cheap Railway Fares.

There has been recently a good deal of comment about the country concerning three and four cent railway fares. We do not think it good policy to obstruct or interfere in any way with economy, and we believe thoroughly in the principle of "small profits and large sales." But in this particular instance we very greatly fear that the tendency on the part of the electric railway people is to do more than is good for their ledgers. There may be a few instances where close competition for business would seem to justify the cutting down of fares, especially where electric roads are reaching for the patronage heretofore enjoyed by steam suburban service.

But the practice is hazardous, and we think it ought by all means to be discouraged. For five years or more street railway systems throughout the land have been undergoing transition from horse or cable-power to electricity. Great expenses have been incurred; and while we have the right to rejoice over the fact that electricity has considerably cheapened railway service, yet plenty of time ought to be given for companies to recoup themselves for outlays in making changes before it is proposed to cut down fares

Much unfavorable comment occurs daily in the lay press concerning faults in service, negligence resulting in accidents, poor accommodations, etc. Some of these complaints are undoubtedly justified, and the demand just now is for better service, safety devices, fenders, etc., that will reduce the number of accidents, and for extension of lines into regions not now occupied.

Let us by all means stop the cry for three and four cent fares, and keep up the other cry for greater safety, fewer accidents, shorter hours for motormen, and more pay for better service from them. If this policy is persevered in, much of the unpopularity that electricity is now burdened with, will be removed, and there will then be plenty of time to urge lower fares if that policy shall seem to be desirable.

* * *

Long Distance Electric Roads.

The time is almost come when those engaged in transportation will have to meet the question of the transportation of passengers and freight over long distances, by means of electricity. It does not appear that very long trolley lines are yet economical, and up to the present time it is necessary to have central stations at intervals of not more than 25 miles.

The project recently sprung, to operate a railway between Chicago and Pittsburg by connecting electric roads already in operation, brings the question into the forefront as a vital issue.

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The Pennsylvania railroad has now in court an application to prevent the building of such a line from Baltimore to Washington, on the ground that the charter of the projected road does not allow it to carry freight, and on the further ground that the charter does not give it the right to haul passengers through the country between the towns. Of course such contentions must apply only locally, and in the one case in point, but this action of the Pennsylvania road ought to be sufficient notice that every foot of ground along this line is to be fought. To wide-awake managers, no suggestion advising complete development of plans before beginning work, will be necessary. Nor will it be necessary to suggest that the steam roads are looking up the laws concerning "rights of way." Before long there will be a demand that electric roads be made to pay for their rights of way through property, just as the steam roads are compelled to do, instead of occupying the public highways, as they now do.

All these questions will bear watching in State legislatures and elsewhere.

* * *

The Speed of Electricity.

The speed of electricity under the most favorable conditions is now established to be 180,000 miles a second. What this enormous speed implies is somewhat dimly suggested by an illustration recently used by the eminent scientist Sir Robert Bell. Suppose that a row of telegraph posts 25,000 miles long were erected around the earth at the equator. Suppose that a wire were stretched upon these posts for this circuit of 25,000 miles, and that then another complete circuit was taken by the same wire around the same posts, and then another and yet another. In fact let the wire be wound no fewer than seven times completely about this great globe. We should then find that an electric signal sent into the wire at one end would accomplish the circuit in one second of time.—*St. Louis Globe-Democrat.*

That would seem to be quick enough for all practical purposes, but now that that part of it has been arranged, if the balance of the distance—that portion which is conveyed by the aid of the messenger boy—could be covered within say an hour or two, the service would be fairly satisfactory.

* * *

Very Ltttle to Spare.

The CHICAGO DAILY NEWS, in discussing the application of electricity as a substitute for steam power, says, among other things:

"This revolution in motive power is of enormous significance to the whole people of a city like Chicago. About half the offenses of such a city come from the use of steam. Steam means smoke, noise, cinders, gases, waste, littered grounds. * * * * If it (electricity) could be produced in properly constructed central stations and applied to all the wheels now turned by steam Chicago would instantly become almost a new city."

If the NEWS is going to do away with steam power altogether it must hope to use some of the wind that Chicago is famous for to drive the generators with. The wind, by the way, is already kept pretty busy blowing Chicago's horn and dangling with the hirsute appendages of Postmaster Hesing, and it is a question just how much is available for other purposes.

* * *

Honor to Whom Honor is Due.

Judge Coxe's decision at Elmira, sustaining one of the earlier Van Depoele trolley patents, will serve at any rate to call attention to one of the most scientific electricians of this generation, and one whose work has been almost wholly neglected by history. In his decision of the case in point Judge Coxe, among other things, said:

"Although the electric road of today is a composite organism to which many ingenious and able men have contributed, yet it cannot be denied that to Van Depoele, more than to any other man, belongs the credit of having made it a practical working success. His contributions to the art rapidly supplanted the crude and tentative prior structures and have continued in use until the present time. No one can read this record without being impressed with the truth of this proposition, and this being so the court naturally approaches this controversy in liberal spirit and with an inclination to give the inventor the full fruits of his invention."

* * *

Walter H. Knight, chief engineer of the railroad department of the General Electric Company, is credited with saying that "electric motors can be built which will make the run from Chicago to Buffalo at the uniform rate of 150 miles an hour, and the distance between New York and Chicago may be covered during the hours of daylight." Assistant Chief Manager Bailey of the same company adds that "such a road can be built and operated with safety." The fellow who wished for the wings of a dove that he might fly will soon find the gratification of his ambition within the range of possibilities.

Our anxious and interesting friend, The Western Electrician, explains, or doesn't explain, in half a column of space in its last issue why the sins of omission and commission of City Electrician Barrett have grown so momentous and portentous since that official became interested in the publication of an electrical journal. But it doesn't even attempt to explain how it happens that it has allowed Mr. Barrett to run riot over the sacred rights of the dear people, etc., until an opposition electrical journal came upon the scene. How some things do open some people's eyes!

In the case of Marie Barbari, the Italian woman of New York, who was sentenced to death, it seems unlikely that the penalty of the law will be carried out. There is in the first place an aversion to capital punishment on general principles in the case of women, and to this is added the strong and growing feeling against the use of electricity for such a purpose under any circumstances. The pressure on Governor Morton for a commutation of sentence to life imprisonment is becoming so strong that it is likely he will be induced to make use of his prerogative.

We modestly but firmly protest against the use by some of our enterprising contemporaries of two pictures of the late Professor Morse, one presenting a thin, smooth-faced man of consumptive mien, and labeled, "Before he received recognition," the other a ruddy, full-bearded man, clearly in the enjoyment of robust health, and labeled "After he received recognition." Our repugnance grows out of the similarity of these presentations to the patent medicine advertisements "before and after taking."

In one day, July 9th last, there were issued from the United States patent office, six separate patents on car fenders to as many people. Two questions arise in connection with this record: 1st. Are any of them any good, and if so, why is there any longer occasion for the companies to excuse neglect in this behalf on the score that there is no commercial fender? 2d. Do all these patented fenders differ in principle, and if not, why are they issued—just to encourage litigation?

Our always interesting contemporary, The Electrical World, has been figuring out the amount of light that could be generated by an amount of power equal to the ordinary working capacity of the human heart and other muscles of the body. Has it ever occurred to our statistical friend that "muscle" has been called upon somewhat too freely to give light, while that other and supposedly inexhaustible source of light—the brain—has been unduly passed over?

Our shrinking sister, Electrical Engineering, objects to THE ELECTRICAL JOURNAL as a literary production, but admires its advertising columns. We, on our part, reciprocate by admiring the literary character of our contemporary, and we have no doubt that we would admire its advertising also if it had any. We are nothing if not optimistic, and we have the happy faculty of seeing good even where others fail.

The announcement comes from Washington that the Solons will legislate next session by electric light whenever there is night work to be done. We have been burdened for some time with the thought that legislation as a rule at the national capitol would be the better for a little more light, and heaven knows some of the legislators need light on many and divers subjects with which they attempt to grapple.

Will some of our Eastern friends kindly inform us why the Committee on Electrolysis of the Firemen's Association hap-

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pened to meet in Boston just at the time of the Christian Endeavor Convention? And may we be further informed whether there were joint sessions?

To some of those journalistic critics who so persistently want The Electrical Journal to be different to what it is we might suggest, in the language of the poet, that:

"The man who gives a public dinner, lookss
To please his guests, not other people's cooks."

Of course we know that news is scarce in the summer time, and that gray matter is a little sluggish, but if some paper, daily or technical, would just get out one issue without referring disrespectfully to "the poor old horse," how grateful we would be!

It might reasonably be a question of doubt with the Baltimore & Ohio Railroad Company whether the expense attendant upon their experiments with electricity at the Baltimore tunnel should be charged to construction or advertising account.

Dr. P. J. Gibbons, of Syracuse, is the latest candidate for permission to demonstrate that electrocution does not electrocute. Who is it stopping the doctor? And by the way, George D. Burton is still alive and the great question unsettled.

In Chicago there are in daily use more than 500,000 incandescent lamps and 20,000 arc lamps, and yet the grand juries and the police are asking for more light on many subjects. Some people are sometimes blinded by too much light.

The news from Philadelphia that the street railway companies there pay the councilmen something like $500,000 a year to keep them in line, will have a tendency to raise the market value of aldermanic services all over the country.

After all is said and done about the horrors of electrical executions, we believe we have failed to hear of any of the electrocuted committing any more murders. And is not that the consummation devoutly to be wished?

The French Academy is having some trouble to determine the temperature possible in electrical furnaces. We would respectfully suggest that the whole matter be referred to the weather clerk at St Louis.

Nothing short of an investigation by Congress will ever determine the whereabouts of the "electrical experts" in the patent office. Then after they are found let us find out why they are there.

We regret exceedingly to announce that, owing to illness of Dr. Thomas, the articles on Photometry will not be ready until our issue of Aug. 15. They will then be presented without interruption.

One of two things may be put down as beyond cavil. Either Philadelphians are not all as slow as they get credit for being, or else their aldermen are an imported product.

Would it not be proper to call the new horse meat canning concerns Societies for the Prevention of Cruelty to Animals? The business of both is to preserve the horse.

Is electricity cold instead of hot, as is being claimed by a Syracuse doctor? And do we get cold roast to order from an electric range?

After all the fuss that has been made about it, and after we have worried ourselves sick, the General Electric will not move.

They are now talking about "neglected evidence in the Berliner case." Good Heavens! was anything neglected?

Won't some one, out of charity, say or write something about Berliner? It has been days since we heard the name.

A BRAVE MAN.

Editor Kohlsaat threatens that the telautograph of the future will furnish all the newspaper portraits. Let the change come. Who's afraid?—*Cleveland Plain Dealer.*

ERNEST P. WARNER.

Among the men who have helped to develop the electrical business of this country and especially throughout the West, the name of Mr. Warner holds a prominent place. He was born in Brooklyn, N. Y., but his parents were among those who early recognzied the great possibilities of the West and then set out for Chicago while Ernest was yet only four years of age. As a lad he spent his time between Chicago and Ottawa, Ill., obtaining his education in the latter city, graduating from the High School there in 1868. He then entered the employ of the Western Union Telegraph Company as an apprentice in the manufacture of electrical apparatus, and served for three years in that capacity in their factory at Ottawa. In the spring of 1872 he came to Chicago, and was engaged by the Western Electric Manufacturing Company, which was afterwards succeeded by the Western Electric Company. With this company he has been associated ever since, advancing to important positions as the business of the company developed. He has achieved marked success in the design and construction of experimental apparatus and in exploiting and carrying out the inventions of many noted scientists, and in addition has made numerous inventions in the field of telegraphy and electric lighting, besides being actively engaged in the perfection of new designs for electrical purposes of various kinds.

An important part of Mr. Warner's duty is to guard the patent interests of the company by which he is employed, and a large portion of his time has been spent recently among the patent papers of the attorney's office, and in the courts as an expert witness.

A SONG OF PROGRESS.

How fast this old world moves along, with science as its guide!
(John, fire up the carriage; I am going for a ride.)
In darkest space it leaves a rare illuminated path.
(Order six yards of lightning for a quick electric bath.)

How various its inventions! They dazzle sense and sight!
(John, cable there to London for a dinner Wednesday night.)
How swift the march of science, though pessimists may laugh.
(Here's Mollie's picture, painted by the new telautograph.)

It's forward, march! forever—the great, progressive plan.
(I see they've put new life in that electrocuted man.)
It's forward, march! forever—in spite of bolts and bars.
(I'm going to strike that air ship for a trip around the stars.)

—*Chicago Times-Herald.*

The horse will always be useful in drawing ambulances for the victims of trolley cars and bicycles.—*Chicago Chronicle.*

No, all this will be done by motor carriages.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students. Personal and Pertinent.

AN ANNOUNCEMENT.

For the information of those students who have been impatient to know the result of the examinations recently held by the classes whose work has been finished, it may be stated that nearly all the papers have been corrected, and the percentages marked. Results will not be published, but each class will be advised separately of the results, and certificates will be awarded to those who have merited them.

Students may not expect that every one who has tried the examinations has received a percentage high enough to merit a certificate of scholarship. The value of certificates issued will be fixed by the commercial public, and by other educational institutions, on a basis of the knowledge possessed by their holders, and is to be a feature of the school that its certificates of scholarship shall be in fact a guide upon which intending employers of men may reckon without fail.

Those who failed to receive certificates this year, should go into the work again with renewed determination to succeed at the end of the next course. It should be understood that failure to pass the examinations is no disgrace; in the first place, they have been purposely made difficult; in the next place, students occupy such a variety of positions in life, their training has been so diversified, and their opportunities so different that it will not be possible for all, even the best students, under existing circumstances, to win honors.

While we are on this subject it may not be amiss to discuss briefly some of the plans for the school for the ensuing year. On the 1st of September, there will be opened in Chicago, a laboratory and work shop, where practical work can be done. This laboratory will be in two parts, one for beginners, and the other for advanced students. Arrangements are already made for a thoroughly experienced laboratory director to assume charge of the practical work, and of the lecture course that will be carried on simultaneously with shop work, so that students may not neglect the principles of the science while their time is devoted to its practice. The idea of inaugurating this laboratory work only in one place at the start, is the same that influenced the inauguration of the first class-work of the school in Chicago—namely, in order that crudities and defects may be overcome, methods improved, and a really valuable and serviceable course outlined while it is yet close under the eye of those whose interests and time are all for the school. If this course in Chicago shall go smoothly, it will be inaugurated at once in New York, Boston and Philadelphia in the east, Cincinnati, St Louis, Minneapolis, Denver, New Orleans and San Francisco in the west, south and north; so that by the first of the year, strong, serviceable, practical work may be under way in all these cities.

The medical department of the school has been thoroughly tested at great expense, and that too will take on the unmistakable character of permanency with the opening of the college year. The work in Cincinnati and Chicago has been more than successful in securing the support and sterling service of men in the various branches of the medical profession whose names stand for the best in their art. The course in Chicago has been especially successful. The school was early received with open arms by those in authority, and, as a result, it was given place at the Cook County Hospital—the public hospital of Chicago—on equal terms with the medical colleges. This reception made it possible for an extremely interesting clinical course to follow the course in electro-physics, and that bearing upon the physiological action of the various forms of the electrical current. This clinical course was shorter than it will be again, and numbered only six lectures, the applications of electricity in gynecology, surgery, and nervous diseases being covered in two lectures each. This autumn and winter, similar courses will be given in most of the principal cities of the country. The course has been somewhat modified to meet what have been demonstrated to be the wants of the profession. The physical part of the course has been pruned, until it contains only those subjects of vital importance to the profession. Somewhat has been added to that part of the course treating of the actual working of medical and surgical apparatus. In this course throughout there will be, as there has been, a very honest and earnest effort to give to the busy practitioner an accurate knowledge of electricity, as it is known to the best physicists, and to those in the medical profession who have given it hard and exhaustive study.

Finally, in closing this announcement, if it may be so-called, it may be said, without breach of confidence of the financial management of the school, that the school has come out of its first year's work with a margin on the right side of the ledger sufficiently large to enable it to better its methods, increase its apparatus list very materially, do some things it had not dare attempt before in the way of thoroughness, and above all to state that The National School of Electricity is upon a permanent footing and permanently installed in educational work in its own special sphere.

DETROIT, Mich., July 1, 1895.

TO THE NATIONAL SCHOOL OF ELECTRICITY,
Chicago, Ill.

At a meeting held June 24 it was unanimously voted that this class, organized by the National School of Electricity August 6, 1894, and finishing the course July 1, 1895, express their entire satisfaction in the method of instruction and in the course as prescribed by the school. The members of the class feel that they have derived a great deal of benefit from the course on account of the simple, practical and up-to-date manner in which the different subjects are treated, and that the time and money invested has been well spent. We wish the school all possible success in other cities.

We heartily recommend the course to all practical electrical workers and others interested in the subject who desire a thorough, practical knowledge of electricity at a very slight expense.

The members also desire to thank Mr. H. R King, instructor of the class, for the able manner in which he has conducted the same.

EDWARD P. GILROY,
President.
P. N. H. MUNSON,
Secretary.

Edward F. Schurig, city electrician of Omaha and president of the Omaha class of the National School, has just spent ten days in Chicago investigating the fire and police alarm system of that city with a view to arranging for a similar system in Omaha. The Gate City has reached a point in its history where the best in any line is none too good, and before making any change in the important matter of fire and police service, felt that it would be money well invested to ascertain what experience has proved to be the best in other cities. The Chicago system is conceded to be the best in the country, and if Omaha patterns after it she will have a most excellent service.

The Racine class congratulate themselves that they have secured Dr. C. R. Hindley as instructor to succeed Mr. B. B. James, who leaves the city for Joliet, Ill., the scene of his future work. This class is already considering, not whether they will reorganize at the end of the term—there is no doubt about that—but the advisability of having the lessons alternate with instruction in elementary mathematics.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

The Central Union Telephone Company of Toledo, O., will erect a $60,000 building to be used as central headquarters.

Owing to a war between rival telephone companies at Frankfort, Ind., the rental of instruments has been reduced to $1 a month.

An agitation in England looks to government control of the telephone system of the country. A committee appointed by the House of Commons has been looking the matter up.

The telephone companies are introducing the dime-in-the-slot instruments into the public "pay stations." By this means it is necessary to pay the cost of telephoning before a conversation can be held.

Logansport, Ind., will have a telephone service costing subscribers not to exceed $18 per year for business houses and $12 for residences The city will also have the privilege of stringing its fire alarm wires on the new telephone company's poles besides having free service for a number of city departments and public institutions.

In New York State on September 1, a law will go into effect which constitutes it a punishable offense entailing a maximum fine of $1,000 or imprisonment not exceeding six months for the employes of te'ephone companies to divulge the nature of any conversation which may pass over the wires between parties who make use of that means of communication.

"It's an ill wind that blows nobody any good." Competition between rival telephone companies at Michigan City, Ind., has reduced rates from $4 per month for business houses and $3 for residences to $1 and 66⅔ cents respectively. The next step will be to make the service free with the added inducement of a chromo for every five minutes conversation.

A bill has again been introduced into the Illinois legislature providing for the regulation of rates to be charged by telephone companies. In cities of 1,000,000 or more inhabitants the limit is fixed at $78 per annum; in cities of more than 500,000 and less than 1,000,000, $66; in cities of more than 100,000 and less than 500,000, $48; in cities of less than 100,000, $36. The bill also provides for a tax of 3 per cent. on the gross receipts of telephone companies.

Light and Power.

Adrian, Mich., is negotiating for the purchase of its own electric lighting station.

By the first of September the Lake street "L" road of Chicago will be fully equipped as a third rail electric line.

A special committee of the Milwaukee city council has recommended that the city build its own electric light plant at a cost of $345,000.

Kansas City, Mo., aspires to having her wires under ground and a committee has been appointed to report just how to best accomplish that end.

Long distance transmission of power is practically demonstrated in the case of the Folsom, California, plant, where the current is transmitted to Sacramento, a distance of 15 miles.

The epening of the Folsom Water Power Company's electric plant at Folsom, California, which transmits power to Sacramento, was attended by the booming of cannon, 1'0 guns being fired.

Milwaukee is getting ready to call for bids for lighting the city, beginning January 1st next. A bid of $90 or less will be necessary in order to meet the expectations of the board of public works.

Nevada City, will within the next three months, have its mines operated by electricity brought from a distance of six miles, where dams are being constructed to furnish water power to operate the generators.

Savannah, Ga., has, within a distance of twenty-six miles, something like 10,000 horse power going to waste. Those who are interested in the progress of the town are watching the operations at Niagara with a view to profiting by the experience obtained there in the transmission of power over long distances.

By the aid of electric lighting, the State Fair at Columbus, Ohio, will be in operation evenings the same as in day time. A plant capable of providing 150 arc lights of 275,000 candle power has been installed at a cost of $18,000. It is hoped that the management will be reimbursed for this outlay by 40,000 additional admissions on the four nights that the fair will be open.

Judge Showalter, of the United States Circuit Court, has handed down an opinion denying the application of the Brush Company for an injunction against the Western Electric Company in the matter of patents bearing on the use of a double set of carbons in arc lamps. This case has been in the courts for a number of years.

Electricity for the purpose of towing boats on the Erie canal will at once have an experimental test. A contract has been made between the Trenton Iron Works and the General Electric Company for the construction of four miles of the necessary apparatus. The experiment will be made in the vicinity of Tonawanda, and will be completed within sixty days. The cost will be $2,500 a mile, or $5,000 for a line on each side of the canal, equivalent to about $2,000,000 for the entire length of the canal.

The San Joaquin Electric Company has let contracts for supplying electric machinery, wire, insulators, water-wheel plant etc., and work is being pushed. A mile of the big ditch carrying the water from the north fork of the San Joaquin River to the great reservoir is now completed, and work on the reservoir is well under way. Machinery to generate one fourth of the power will be put in as soon as possible, at a cost of about $200,000. The total power that can be generated is about 8,000 horse-power. The company has decided to build a sub-station in Fresno, and this will be the distributing point for the mills, factories, car lines, etc., and for the vineyards within a radius of six or eight miles. The ditch and reservoir will be completed by the middle of October, and it is expected that by the beginning of next year the power will be delivered in Fresno. Should more than 8,000 horse-power be required other wheels can be put in. There is practically no limit to the power that can be generated in the mountains.

Railways.

An underground electric railway is contemplated in the heart of London town, running between Shepherd's Bush and Liverpool street, a distance of six and a half miles.

In Detroit a three cent fare is in vogue, and in Cleveland where the street railway company is asking for additional privileges, one of the conditions insisted upon by the city is that the fares shall be reduced below four cents.

The STREET RAILWAY REVIEW in its July issue publishes a table showing that within a year 190 electric railway companies have been projected, which propose to build 3,457 miles of line. Nearly every State in the Union is represented in the table. Ohio taking the lead with 31 roads and 751 miles.

The difficulties which were experienced in the earlier tests of the new electric motor at the Baltimore tunnel, have now been satisfactorily overcome, everything is working smoothly and the efficiency of electricity for such purposes is established beyond question.

An electric road from Washington to the battle field of Gettysburg is projected. The distance is 75 miles and traverses a rich farming district. The passenger traffic to this historic point together with the freight that will naturally come to it, is expected to make it a remunerative investment.

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Washington authorities recently arrested the officers of the Eckington and Soldiers' Home Railway Company for obstructing one of the streets of the Capital by the erection of poles to carry trolley wires. The arrests were made under a law passed in 1862 "for the protection of public buildings, grounds, squares and reservations."

A consolidation of the street railway companies of Philadelphia is practically completed. The scheme represents a capitalization of about $40,000,000. It is expected that a saving of a million dollars or more in operation will result by doing away with high-priced management, lobbyists' fees and a material percentage of operating expenses.

Philadelphians have enlisted the trolley car in the cause of charity. Wishing to raise a fund for the German hospital a parade of electric cars was arranged - fifty in number. They were gaily decorated with colored lights and flags and made a twenty mile tour of the streets. Each car carried sixty people. A fare was of course charged and quite a handsome sum was raised.

An electric railway, just completed between Detroit and Mt. Clemens, Mich., is claimed to be one of the best in the country The distance between the two cities is twenty miles and the schedule time is just one hour. The rails used on the line weigh seventy pounds to the yard, and there are 2,640 ties to the mile. The cars are similar in design to those used on steam railways; they are thirty-three feet long, vestibuled at both ends, eight feet wide and mounted on double trucks. A novel feature has been introduced into the service in the form of telephone connections, by which it is possible to telephone to any point from every fifth pole along the route, the instrument being placed right in the cars, a complete Bell metallic circuit being provided for this purpose.

The General Electric Railway Company of Chicago hopes to get permission from the property owners of Wabash avenue to build a line of railway on that thoroughfare to be operated by electricity. They purpose installing an underground system. A well defined opposition, however, has developed among those whose privilege it is to give the necessary consent, but the company apparently is not to be baffled without making a strong fight, as may be judged by the following proposition, which was submitted to a recent meeting of the owners of frontage:

"Owing to the opposition manifested by certain property-owners along our proposed lines we have concluded to change the the policy of the company's business. Instead of keeping the streets in repair from curb to curb and lighting them with sixteen arc lights per mile it is thought best to devote the cost of this to the property-owners who sign frontage and assist us in getting the franchise, as they are entitled to the benefits. The cost of these two items will be computed and paid semi-annually in cash to those who sign their frontage through the life of the company. The division of this money will be upon the basis of the value of the property, according to the assessed valuation thereof The sum of $8 per front foot, payable in the stock of the company, full paid and non-assessable, is also furnished as hitherto provided. This offer only applies to 51-100 of the frontage along our line in each mile, according to law. This places those who sign frontage and assist us in bringing about the road in the same position as the company itself. And those who oppose it simply must abide by the results."

General News.

The General Electric Company employs at its three plants in Lynn., Mass., Schenectady, N. Y., and Harrison, N. J., upwards of 7,000 men.

On the authority of Mr. J. P. Ord, second vice-president of the General Electric Company, it may be said that Schenectady will not lose the work shops of the company, but that on the contrary the present shops there will be greatly extended.

The Washington Post cites the fact that in 1892 the number of horses in this country was estimated at 15,500,000, valued at $1,000,000,000. Three years later, say in January of the present year, the number had increased to 15,893,318, but the value had decreased nearly one half, or $576,730,580.

The following directors were unanimously elected at the recent annual meeting of stockholders of the Westinghouse Electric & Manufacturing Company: Charles Francis Adams, Lemuel Bannister, August Belmont, N. W. Bumstead, A. M. Byers, Marcellus Hartley, George W. Hebard, Henry B. Hyde, Brayton Ives, George Westinghouse, Jr.

Albany, N. Y., has paid out for street lighting by electricity in the past ten years the sum of $930,922. During the same period the total tax budget was $9,274,373. The figures show that one-tenth of the total income of the city has been expended for lighting its streets. An agitation is now going on for municipal ownership of a lighting plant.

G. W. Swan and C. B. Hanna, of Oakland, California, are working out the problem of heating by electricity. They claim to have already succeeded in raising with one heater 1,000 cubic feet of air a minute to 250 degrees. In the matter of domestic application they have been able to "boil over" in three minutes at a cost of 1½ cents an hour for heat. They are not yet quite ready to make public their system, but evidently they are going to make it hot for somebody.

Sacramento, Cal., is already about to reap the fruits of its enterprise in supplying an abundance of electric power for purposes of manufacturing. A proposition has been made by a gun manufacturing firm of Boston to remove its works there if Sacramento will pay the cost of transferring the plant across the continent. The estimated cost is $5,000, and the Industrial Association of Sacramento is disposed to accept the offer. The gun company employs from 40 to 50 men.

Frank W. Hawley, vice president of the Cataract General Electric Company, made a statement a few days since which if true and there is little doubt about it means a great deal for the future of electricity. His statement was that "the dynamos of to day bear the same relation to those of the future that the first crude, clumsy attempts at engine building bear to those modern finished and polished mechanisms that seem instinct with life. The percentage of waste and loss will be reduced until it is imperceptible."

An Auburn, Me., ex-alderman, while sprinkling his lawn, became possessed of a playful spirit, and was about to give vent to it by turning a stream of water on the overhead trolley line that passes in front of his residence. The timely intervention of a lineman prevented him from doing so, however, and now since the ex-alderman has been making inquiries and found what a narrow escape he had, he is asking his friends to congratulate him. The stream of water would have made an excellent conductor, and the chances are he would have been knocked down without knowing for the moment what hit him.

LONG BEFORE THE BELL TELEPHONE.

A correspondent, noting the item recently published relative to the granting of a pension by the German emperor to Miss Reis, who, it is claimed by the Germans, is the real inventor of the telephone, writes the Boston Journal, that in the National museum at Washington may be seen a Reis telephone over which speech has been successfully transmitted, and which was unquestionably invented when Professor Bell was a boy at school.

WANTS KOHLSAAT'S PRIZE.

Joseph Shaver, of Milwaukee, has an eye on the $5,000 in prizes offered by the Times-Herald of Chicago, and hopes in the eighty-five mile race between Milwaukee and Chicago next November to enter a self-propelling road carriage which will distance all competitors. Mr. Shaver's carriage will not weigh 100 pounds in excess of an ordinary buggy and will be propelled by gasoline, and is expected to make an average speed of thirty miles an hour at an expense not exceeding 1½ cents an hour. All parts of the machinery which will have to do heavy work will run on ball bearings and the tires will be cushioned.

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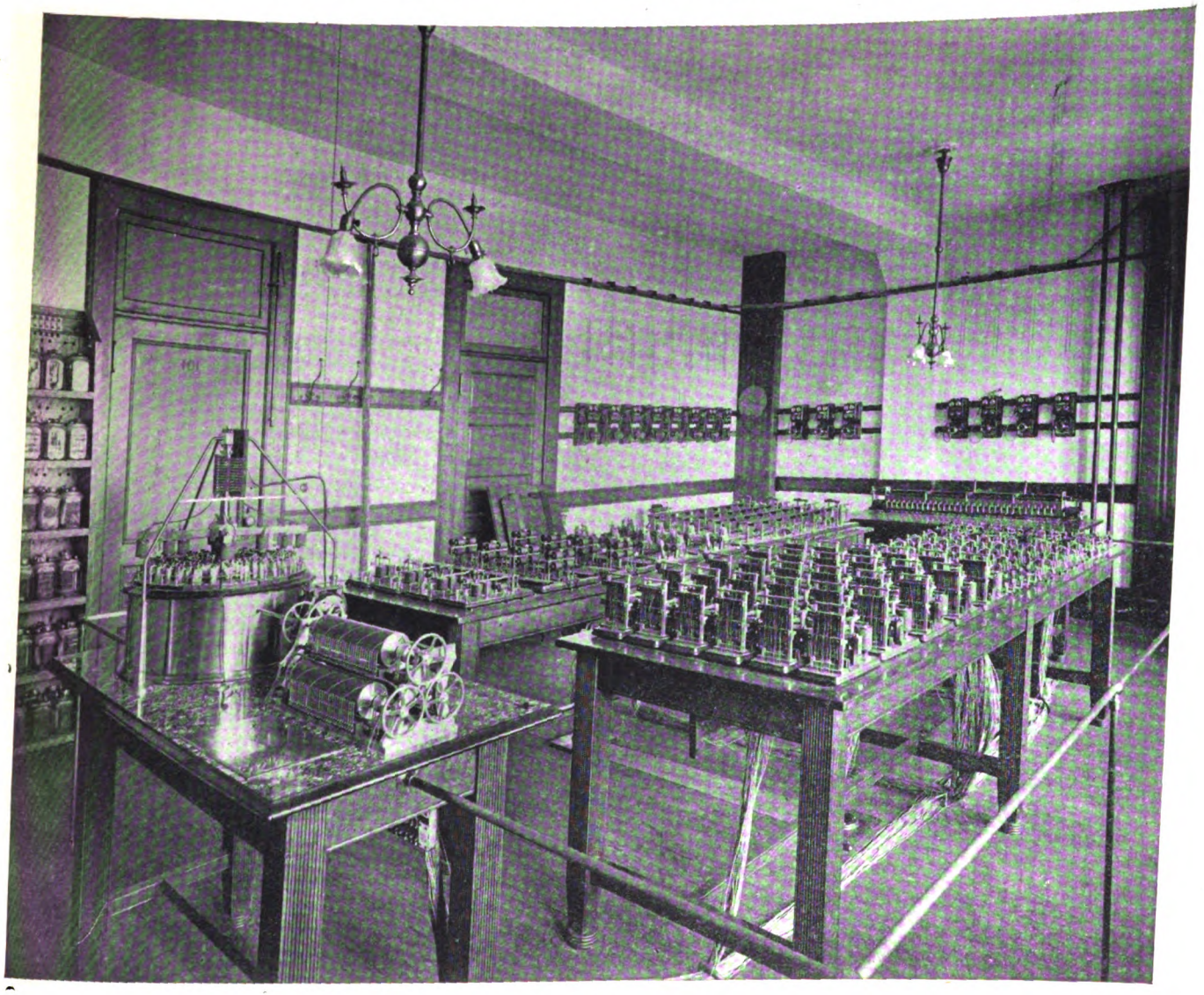
AUTOMATIC TELEPHONE SYSTEM.

Practical Working of a Percentage Exchange—Every Subscriber His Own Telephone Girl.

A large part of the expense in operating a telephone exchange system is the expense of operators for making the connections. The costly multiple switchboards now in general use throughout the country represent an enormus capital investment, the interest on which must of course be paid by the telephone user. In order to abolish the operating expenses entirely, and to reduce considerably the cost of installation, Romaine Callender has devised a percentage system which he has been exhibiting in the Decker Building, New York City, during the past month. A percentage telephone exchange is one having mechanism enough to do the maximum business at the busiest portion of the day. The statistics of telephone exchange connections show that the maximum number of telephones in use at one time rarely, if ever, exceeds twenty per cent. of the total number constituting the exchange. In the Callender system, therefore, instead of an individual mechanism for each subscriber a percentage of mechanism is provided. These are for use of all telephones in common, provision being made by which a telephone subscriber on turning in a call to the exchange individualizes for his own use one of the common mechanisms not in use at the time his call arrives. In following out this percentage principle a large amount of apparatus is eliminated and the size of the exchange is greatly reduced. The apparatus for enabling the subscribers to interconnect themselves at wlll is divided into two principal portions, first, apparatus at the subscriber's station, and second apparatus at the exchange station.

The apparatus at the subscriber's station, in addition to the usual telephone transmitter, receiver, and call bell, consists of a signaling transmitter of special form (see figure 2). Reference to this illustration will show two dials, each numbered 0 to 9, inclusive, together with a handle or lever projecting at the right-hand side. This form of signaling transmitter is used for small exchanges of not more than 99 telephones. For a system not exceeding 999 telephones the same internal construction is followed, with the addition of one more numbered dial, and for a system not exceeding 9,999 telephones, a fourth dial is provided. This signaling transmitter is designed to simplify to the fullest extent the operation of calling or signaling to the exchange station connection with other telephones. It renders the act of turning in a call wholly automatic and obviates the errors of manipulation incidental to the use of keys, revolving consecutive indicators etc. A subscriber desiring to connect himself with another subscriber, say number 36, places the indicator arms over the proper numbers on the dials, reading from left to right. The left-hand dial thus indicating 3, and the right-hand dial indicating 6. He then draws down the lever projecting from the right-hand side and releases it. This is the whole operation, as the signaling transmitter automatically turns in the proper signal. Inside of twelve seconds, no matter what the number called may be, the call-bell rings; one long ring if connection is established with



VIEW OF CALLENDER AUTOMATIC EXCHANGE.

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the telephone called for, or a "busy call" of two rings if the telephone signaled for is in use.

The apparatus at the exchange station consists of the following divisions: selector-connector, numerical receivers, progressive switches and signaling tracks. The selector-connector seen in the left foreground of Fig. 1 is the main controlling apparatus, its function being to apportion to incoming calls some portion of the apparatus not in use at the time. In addition, it afterwards contributes directly to the establishing of a connection between the calling and the called subscribers. The numerical receivers are for indicating the numbers of the telephones with which connections are desired. The progressive switches are auxiliaries for leading up to the act of connecting while the signaling tracks are used for signaling to the sub-

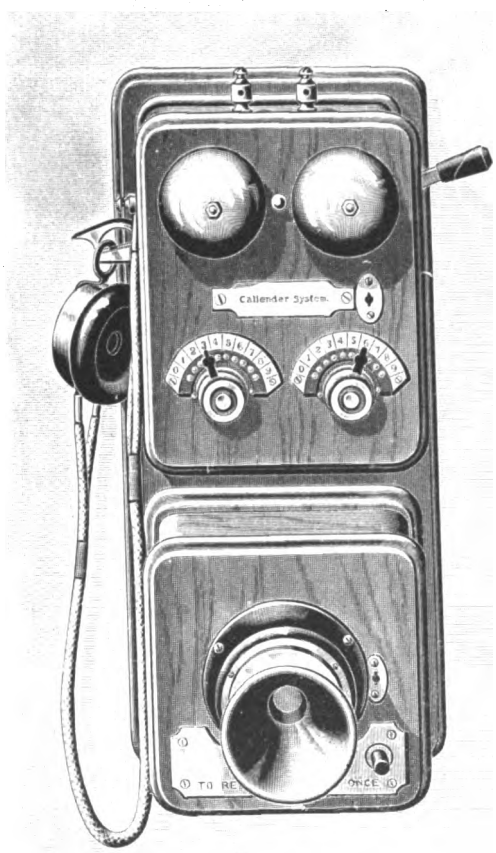

FIG. 2. SIGNALING TRANSMITTER.

scribers and for percentage control and clearing out purposes. The operation of the several divisions just enumerated is as follows: The subscriber on turning in a call to the exchange influences the selector, and as a consequence has apportioned to him some one division of the percentage mechanism used for registering signals. The number of the telephone called for is immediately registered on the numerical receivers of the division just referred to. A circuit closing agent is then liberated and descends the signaling track, in passing along which it "numerizes" or selects the number called for, and with the assistance of the progressive switch, seized and individualized to the use of the calling subscriber, connects the "caller" and "called," if the latter's line is not in use. The call-bells of both subscribers are then run through the further progression of the circuit-closing agent along the signaling track, and finally both subscribers are left in undisturbed connection, all of the apparatus having passed out of their control saving the progressive switch seized and individualized for the calling subscriber and the connector element connecting the subscriber called to the subscriber calling. As conversation is effected through the connector, the elements it controls have the largest percentage proportions, ten per cent. being the maximum, enabling twenty per cent. of the exchange to be in simultaneous communication. The other portions of the apparatus revert to common use directly each has served its independent function. The parts of the apparatus in use for only a few seconds at a time are fewer in number than those in use for longer period of time. In this manner the full benefit of percentage use is obtained.

ELECTRICITY FROM CITY REFUSE.

The subject of how to realize some benefit and profit from the refuse and rubbish of cities is one that is engaging to a large extent the attention of sanitarians and engineers, and there is a decided opinion that the turning of waste into wealth is a problem that will very shortly be solved on practical lines, in spite of the doubts recently expressed by Colonel Waring, the famous street-cleaner of New York.

In England especially this question has been taken up and discussed with much earnestness. The outcome, according to a writer in a recent number of Chambers' Journal, is not merely the adoption of the system of cremating the refuse, but at the same time to use it as a fuel, in the generation of electric power. This project is one that seems to be entirely feasible. It is found by reliable statistics that London alone produces 1,500,000 tons of refuse per annum. All this vast accumulation has hitherto been going to waste. Conveyance to the sea was practiced with success, but it involved the expenditure of a good deal of energy and money. Under these circumstances the adoption of cremators, in which the rubbish is wholly consumed by fire, came more and more into favor, so that at the present moment the majority of the principal English cities are either constructing or about to construct the new refuse cremator. Much heat is necessarily involved in the destruction of the refuse, and the idea is now gaining ground that such heat may be largely and advantageously utilized in the production of steam power and electricity, instead of being permitted to run to waste. The production of a furnace suitable for the most economical combustion of all kinds of refuse has necessarily required much time and skill; and it was only after twenty-five years of close application to the problem that the late M. Fountain de Livet, a French engineer, succeeded in securing a powerful natural draught in furnaces without artificial means, and in consuming rubbish without smoke or noxious fumes of any kind. A destructor erected on the Livet system is now in operation at Halifax, in Yorkshire, and produces, from the combustion of refuse, electric current sufficient for some 2,000 candle-power arc lights, and a search light of 25,000 candle-power. According to recent experiments, the result obtained in the Livet furnace from an ordinary sample of town refuse is pronounced by experts to be equivalent to about one-third or one-fifth its weight in coal—namely, from three to five pounds of refuse will generate as much heat as one pound of coal, while the refuse after consumption is found to be a clean, massive, metallic clinker, well fitted for road material, or after being ground up, for making mortar.

The time is coming, when in one way or another all large cities will find a source of revenue in their refuse and rubbish far above the amounts now raised by taxation for the collection and removal of such accumulations.—*Exchange.*

A. H. Britnell, of Toronto, Ont., has invented a new system of electric propulsion, which he claims will revolutionize present methods There are no trolley poles, overhead wires or brakes used. In fact, no motors will be used. It is impossible, he says, for the cars to leave the tracks, and instantaneous stops can be made when necessary. In addition it is claimed that it will not require more than half the power that is now used to accomplish the same results. The device is yet only in model form, but patents have been applied for, and before long the inventor hopes to give a practical working demonstration.

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MICHAEL FARADAY, D. C. L., F. R. S.

Born in London, 1791. Discovered electromagnetic induction and the laws of electrolysis; the father of modern electricity.

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The Electrical Journal.

Vol. 1. CHICAGO, AUGUST 15, 1895. No. 6

TESTS OF A POLYPHASE MOTOR,

Comparison with Continuous Current Motor — Higher Efficiency of the Latter — Adaptability of the Polyphase for Inter-Machine Uses.

AMERICAN AND FRENCH FIGURES COMPARED.

We hear much in these days in regard to the advantages of two-phase and three-phase alternating currents for the transmission of power, but comparatively little information is obtainable in regard to the actual performance of the motors, as shown by impartial tests that may be relied upon. The records of independent tests made in Switzerland, Germany and France are to be found in various foreign periodicals and in the journals of foreign engineering societies, but very few such records are found in English printed journals. Dr. Louis Bell has given us much information based upon his experience in regard to the performance which may be expected of polyphase induction motors, and Mr. Steinmetz has, from time to time, added much to the general fund of knowledge bearing on their design and performance. Complete tests of American polyphase motors are not presented to us by these gentlemen, though Dr. Bell has given some interesting comparisons between alternating and continuous-current motors. The comparative curves which he gives seem to be almost the only ones which have been presented in America. On

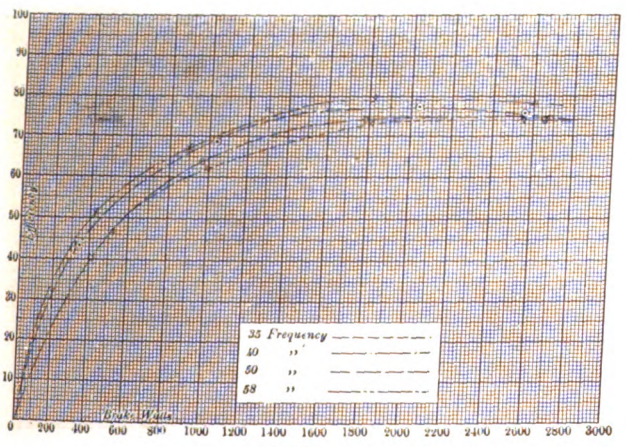

FIG. 1.

this account the results of tests made upon a three-phase motor at the University of Wisconsin are of interest.

Particular interest attaches to polyphase motors at this moment because the manufacturers of polyphase machinery are pushing beyond the boundary of long distance transmission of power into the field of the distribution of power in factories—*inter-machine distribution*, as it may be called. In the latter work the polyphase motor enters into direct competition with the continuous-current motor and the performance of machines of small size must be particularly excellent if they can take an equal place with continuous-current motors. For long distance transmission of power the alternating current presents such remarkable transmission advantages that defects may be overlooked in the motors which would condemn them for use in inter-machine distribution, where economy and close regulation on the part of small motors are factors of the greatest importance.

The motor for which tests are here given belongs to the dynamo laboratory of the University of Wisconsin, and is used for testing in the regular course of laboratory instruction. It was made by the Allgemeine Elektricitaets Gesellschaft of Berlin, Germany, in 1893. Its rated power is from three to five horsepower at a speed of fifteen hundred revolutions per minute, which is the theoretical speed which it should attain at a frequency of 50 (6,000 alternations per minute). The fields of the motor are "mesh" wound for a pressure of one hundred volts

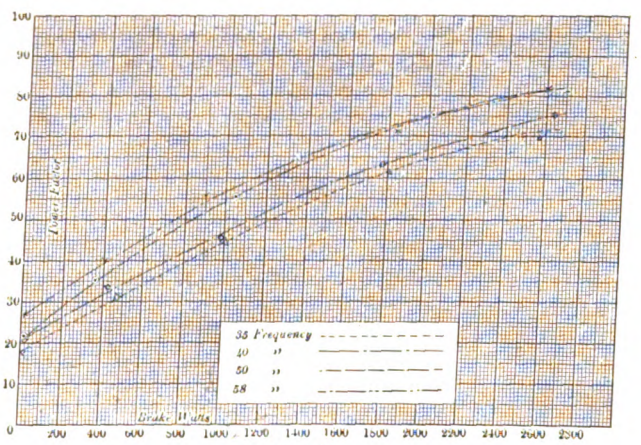

FIG. 2.

between the leads, and the armature is of the common "squirrel cage" type - that is, the armature conductors consist of straight rods threaded through holes close to the periphery of the armature core, all the conductors being connected together at each end by copper short circuiting rings. Tests of the motor have been made with a wide range of frequencies, the tri-phase current being furnished by means of a rotary transformer which furnishes a convenient means of getting three-phase currents of any desired frequency between 35 and 60. The alternating current developed by this rotary transformer is probably quite close to sinusoidal. The transformer is limited in its current-carrying capacity, and the motor has therefore not been tested beyond about 3.6 brake horse power. In testing, the output of the motor has been measured by means of a prony brake, the input by means of a Weston or an electro-dynamometer wattmeter, the current in each circuit by means of an electro-dynamometer, the pressure between the three terminals and the center of the mesh by a Weston alternating current voltmeter, all being carefully standardized.

The results are given graphically in Figs. 1, 2 and 3. Fig. 1 shows efficiency curves for the motor when driven at frequencies of 35, 40, 50 and 58. The revolutions per minute made by the armature of this motor are theoretically thirty times the frequency, or one-fourth the number of alternations per minute. Consequently the theoretical test speeds corresponding to the curves in the figure are 1050, 1200, 1500 and 1740 revolutions per minute. The efficiency of the motor over the whole range of frequencies is very good, and in comparison with Fig. 4 it may

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be said upon the whole to compare favorably with the corresponding efficiencies of a continuous current motor. Fig. 4 is an efficiency curve taken from a five horse-power continuous current motor of a well known manufacturer. The drop in speed of the alternating current motor between no load and full load is about 7½ per cent. at the best frequency, while the regulation of the continuous current machine is almost perfect.

Fig. 2 shows the variation with load of the power factor (ratio of wattmeter reading to product of ampere and volts) at the four

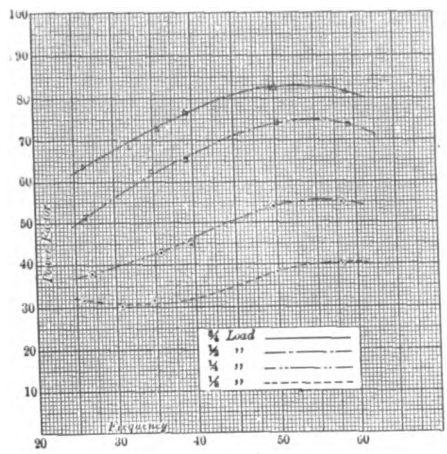

FIG. 3.

frequencies, and Fig. 3 shows the relation of power factor to frequency at different loads, counting full load as five brake horse-power. It will be seen from these curves that the highest power factor does not much exceed 80 per cent., and that this motor must always demand upward of 20 per cent. more current from the generator which supplies it than is actually represented by the motor's output.

Results of tests of a similar motor are reported in L'Industrie Electrique for May 10th, 1893, and agree quite fully with the results just given. The general results are condensed into the attached table:

TEST L'INDUSTRIE ELECTRIQUE.

MOTOR.	TYPE.	H. P.	MAX. H. P. AT TEST.	MAX. EFF. *Per cent*	DROP IN SPEED AT FULL LOAD. *Per cent.*
A. E. G. 3-phase.....	DR 50	5	5	84	6½
WISCONSIN UNIVERSITY.					
A. E. G. 3 phase..	DR 50	5	3.6	80	7½
Continuous current....	.....	5	5	85	0

It is unfortunate that the test on the alternating current motor could not be made upon an American machine of one of

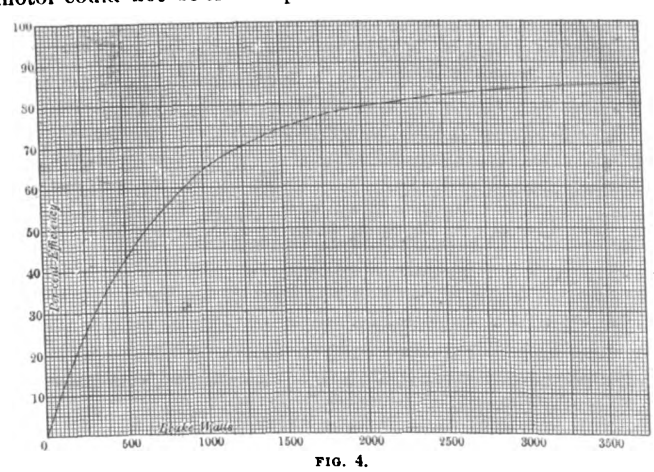

FIG. 4.

the types now coming into use, but there has been none available for the work. The American machines have the same general constructive characteristics as the motor tested, and are likely to differ but little in their performance. The curves show a greater advantage to the credit of the continuous current motor than is given it by Dr. Bell.

GASOLINE VS. ELECTRICITY.

It is doubtless something of a surprise to those who have been looking for the early advent of horseless carriages to find that the experiments tried in France show gasoline to be a faster and more reliable driver than electricity.

The electric enthusiasts, however, will not lose faith in their propelling power, the possibilities of which cannot yet be measured. When the science which is yet "in its infancy" is sufficiently developed to harness the electric horse properly, the gasoline nag will have to go.

But for the time being we shall have to endure the humiliation of seeing the subtle agent we have learned to adore and stand in awe of, distanced in speed and outdone in endurance by a measly cheap inflammable product, chiefly used in cleaning old clothes and blowing up kitchen servants.

The horseless carriage is bound to come into general use and most of us have made up our minds that electricity is going to be the horse's substitute. And so motor be.

We don't propose to recognize petroleum as electricity's superior just yet, although it must be confessed that it has been making a mighty good record for itself as a vehicle propeller.—*Detroit Journal.*

WORK, NOT GENIUS, COUNTS.

We cannot have too much education of the right kind, and if it be rightly applied it is of inestimable value to the citizen in every walk and branch of life. What your education will be and do for you depends upon yourselves. No measure of genius, so called, will take the place of well directed hard work in any and every calling of life. There is no royal road to learning, no substitute yet discovered for industry. You have seen, as well as we all have seen, the most brilliant man overtaken in the race by one known in the class-room for indifferent ability, but always the plodder, pushing on and on in the face of the inherent disadvantages, to the successful realization of a high and determined purpose. No college can make you great, no university can make you successful. These achievements, and it is the commonest experience of mankind, these achievements depend upon yourself. The secret of getting on is to keep always moving toward a cherished object. The way-train may have the same running schedule as the through train, but the latter reaches its destination first because it makes fewer stops and keeps going. Exertion is the secret of success in life. *Gov. Wm. McKinley, at Evanston, Ill.*

LOSING MONEY SLOWER THAN EVER.

The railroad situation of the country to-day reminds the Railway Review of a story.

An easy going sort of a fellow was a renter in the farming line and took a new farm each year. Finally a friend, knowing him to be honest and straight so far as money matters were concerned, got him on to a place at some little distance from his former haunts, hoping that a change of locality might bring a change in habits and in success. Some little time thereafter business called him past the farm As he rode past the man hailed him. "Hallo, is this your farm?" "Yes, and I jest come over to thank you and tell you I was a-goin' to pay some of that money before long." "You must be doing well." "Yes, 'Squire, I'm a doin' first-rate, and I am powerful obleeged to you for a-havin' headed me this way." "Are you making any money?" His face brightened and he replied hopefully: "Well, no, I ain't, 'Squire, but I'm a losin' it slower'n I ever done in my life before."

Another protective association has been formed among the independent telephone companies. It is known as the Eastern Telephone Protective Association, and has its headquarters in the East. At a recent meeting at the Astor House in New York, officers were elected and a line of policy agreed upon, the main feature of which is to guarantee protection to small towns and to individuals who may contract to use telephones supplied by the members of the association, should any claim arise on the ground of an infringement of patents.

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ELECTRIC WELDING FOR REPAIRS.

Considerable progress has been made in the utilization of the electric arc in the manufacture of articles which require welding without extending the effect of the intense heat over large portions of the substances which are to be joined. In the concentration of the heating effect of the electric process lies the economy of this method, and its adaptability to repair work is being illustrated by the experiments undertaken by foreign engineers, who have shown that there is a deal of this class of work which may be easily and economically performed by the use of the electric arc. The best known process is the Bernados system, in which small pieces of metal may be fused and joined to larger pieces. In this process worn journals, broken gears, castings or forgings may be built up or repaired, frequently without removing the broken part from the machine of which it is a member. This application of the electric process is by no means narrow, but it is more valuable in works where large machinery is built than in railway shops. Yet if a welding plant is once installed there are many ways in which it will be found to be useful. For instance, it is not uncommon to see cases of broken locomotive cylinders in railway repair shops which have been mended in a very expensive manner by cutting out metal at the broken places and dovetailing brass blocks or strips in them. The cylinder then requires banding to keep the parts together and furnish the strength required to take the place of that which has been lost by the breaking of the casting. This work is frequently tedious and it may be said to be invariably expensive.

The experience of the foreign engineers who have taken part in the discussions upon the subject of repairs with the electric arc in the meetings of the North-east Coast Institution of Engineers and Ship Builders would indicate that such work as this could be satisfactorily performed and at comparatively slight expense with this process, after the necessary electric equipment was procured. The power required for such work does not exceed 70 indicated horse-power and the electric plant may be of low tension, such as is used for electric lighting providing the capacity is sufficient. Extensions of electric plants in railway repair shops are certain to come, even if the progress is slow, and the great variety of uses to which the current may be put will greatly affect its value as an investment. It is possible to use the same equipment for lighting, for power, for handling material on cranes and transfer tables, as well as for driving machinery direct, and by the use of the Bernados system electric welding may also be accomplished with the same currents. Another and perhaps the widest field for such a process lies in the applicability of the electric arc in boiler repairs. At the recent meeting of the institution referred to, Mr. Henry Foster reports that for boiler repairs the electric arc is most efficient and that with it patches may be applied in difficult places where riveting would be impossible without taking the boiler to pieces. He cites an instance of a patch which was placed over a hole five and one-half by three and one-half inches with a lap of one and one-half inches all around. The patch was placed in position and the junction with the boiler plate was welded and the patch and plate thoroughly incorporated together so that the patch became a part of the shell. The work, including cutting out the defect in the plate and applying a hydraulic pressure test, occupied but ten hours.

An important development of electric welding called the Slavianoff process, is reported to be successful in every day work at Berlin, where it has undergone two years of experimenting and practical trial. This process consists of fusing one of the electrodes itself, and may more properly be called an electric casting system. The process makes use of the electric arc, and both of the electrodes are of metal. One of them is a bar of the metal which is to be fused, and the other is formed of the article to be repaired. The welding electrode can be used for filling up crevices, holes and worn surfaces, and it may also be used to repair axles, shafts, fly wheels, etc. The process is pronounced a practical success, and it has the merit of simplicity and does not require specially expert operators to secure good results. It is not expected that these processes will be at once taken up by railways, but from the practical successes made in other branches, the electric welding processes will bear watching and will undoubtedly prove themselves to be equally useful in locomotive work. This possible field for electric power, in addition to those in which it already has application, should be considered as another point in favor of adopting electrical distribution of power in shops for locomotive construction and repairs.—*Railway Review.*

NEW USE FOR THE PHONOGRAPH.

An Undertaker Uses It to Perform the Last Sad Rites Over the Dead—Sings and Prays.

Down in Gravesend, L. I., there is a first-class specimen of the country undertaker. His name is Abraham Stillwell. He is usually called "Uncle Abe," and he is given the credit of being a real old-fashioned countryman about a mile behind the age. He has proven, however, that he is not so far behind the times as it would appear, and he has taken a novel manner of doing it. He has purchased a phonograph, and hereafter whenever the occasion offers will use it as the principal feature at funeral services. It has been loaded with a sermon that can be used at any funeral, a quartet hymn, and a tenor solo. It has been his duty to bury bodies that might come in from the sea without any special ceremony, and he was considerably worried over it, being a good Methodist.

One day recently when down at Coney Island he heard for the first time a phonograph. An idea struck him. He would buy one, have a funeral service said and sung in it, and use it when a minister could not be got. Without delay he purchased one of Edison's inventions. For some weeks he hurried about and finally found a minister who agreed, for humanity's sake, to preach a sermon in the machine. The other night, when there was no one about, "Uncle Abe" and the minister stole into the back room of the latter's house and there the sermon was preached into the unaffected ears of the phonograph.

It is so constructed that it will serve for the funeral of any one. Later a male quartet sang "Nearer, My God, to Thee," in the machine. Next came a tenor solo, "Flee as a Bird." The services were concluded with a prayer. Then "Uncle Abe" waited. He had hopes of using his patent funeral service over the body of George Pettit, of Sheepshead Bay, last Saturday, but the relatives of the deceased decided at almost the last moment to have a local pastor officiate. He expects to work off the services on the next body that floats ashore, however.

WANTS INFORMATION.

A correspondent inquires for the name of some publication "that gives the whereabouts of all existing electrical plants and of those to be."

The most complete information of existing plants that we know of is Johnston's Electrical and Street Railway Directory, published by the W. J. Johnston Company of New York, 1894. We understand a new edition is now being prepared. A very complete list of street railways may be found in the regular issues of the Street Railway Journal and Street Railway Review. Electrical Industries, of Chicago, also publishes a directory of information. To give the names of all the electrical plants that "are to be" would call for a prophetic spirit, which has not yet materialized even in the electrical business, so far as we know.

Many persons continue to doubt the efficacy of electricity as an agency for killing criminals. They assert that it merely stuns and does not kill. If New York could make arrangements hereafter to expose its murderers to a stroke of genuine lightning it might satisfy these doubters, even if it could not prevent the further use of that dreadful word electrocution.—*Chicago Tribune.*

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THE SCIENCE OF PHOTOMETRY.

Measurements of Light and the Methods Employed — Prismatic Values of Light and Color — The Spectroscope and Its Uses.

TABLES INDICATING COLOR INTENSITY.

Photometry is that branch of physical science which treats of the measurement of light. Its primary object is the determination of the intensities, or light-giving powers, of various sources of light, and the determination of illumination, or the quantity of light falling on a given surface, without reference to the source from which the light comes.

Properly speaking, light is a sensation, produced by the action on the retina, of a wave motion in the ether. Waves are set up in the ether by all kinds of matter which are at a temperature above the absolute zero (−460 degrees Fahrenheit). A body at low temperature sets up only comparatively weak waves of great wave length. As its temperature is increased, the intensities of waves produced at lower temperatures are increased, and new waves of shorter wave-length are added. The ether waves produced by such a body are not capable of producing the sensation of light, if the body be at a temperature below 977 degrees F. At that temperature waves are produced which cause the sensation of grayish red light. At higher temperatures, the body being solid or liquid, waves are added which produce separately and successively sensations of bright red, orange, yellow, green, blue, indigo, violet and lavender, if viewed through a good spectroscope. If the waves pass directly to the retina, without separation by the prism, the color impression produced is that due to the combined action of all the rays present, passing from low red to cherry red, orange, yellow, white and bluish white, as the temperature of the source increases. At higher temperatures, other waves are added, which have no visual effect.

All ether waves move through the ether at the same rate—the velocity of light—about 186,000 miles per second. They are usually distinguished by their wave length, which is measured by appropriate methods. The wave lengths of visually active waves range from about sixteen millionths of an inch for violet, to about thirty millionths of an inch for dark red. Professor Langley has measured wave lengths as great as 680 millionths of an inch, and others have measured waves only ten millionths of an inch long. The eye is, therefore, sensitive to only a small part of the waves given off by a white hot body.

If radiation of any wave length fall on a lampblacked surface, it is absorbed and converted into heat, which, when measured, gives us the mechanical value of the radiation. It is found that equal amounts of radiation, so measured, have very different light-producing values in different parts of the spectrum. Palaz (Industrial Photometry, page 14) gives the following table:

	DARK RED.	RED.	ORANGE.	YELLOW.
Luminous sensation.....	1	1,200	14,000	28,000

GREEN.	BLUE.	VIOLET.
100,000	62,000	1,600

The eye is, therefore, most strongly excited by green light. The relative lighting values of different sources evidently depends upon the relative quantities of red, yellow, green, and blue light they produce.

Photometric methods have been proposed and used, which are based on the measurement of the heat-effects produced by radiation (or waves of all kinds) from the given source. These methods are useless because they take into account waves which are visually inactive. Modifications of these methods have been tried, by cutting off the inactive waves by proper means, but these methods are useless also, because energy values and visual values vary so widely in different parts of the spectrum, as stated above. Methods based on the amount of chemical action produced in photographic plates or otherwise, are useless for similar reasons. We use artificial sources of light to enable us to see things distinctly, and, with the above facts before us, it is almost a truism that no photometric method is of value, which does not include the eye as an essential part. We may then confine ourselves to the consideration of eye methods, and of visually active waves, which we may call light.

All photometric methods which have proven valuable are based upon the comparison of the brightness of illumination produced by the source under test, with that produced by a standard source of light. This is usually done by allowing the light from the two sources to fall upon adjacent parts of a sensitive screen, and moving one or both sources until the two parts of the screen are equally lighted. The two light intensities are then proportional to the squares of their distances from the screen. This may be proven as follows: Suppose a lighted candle placed in front of and ten feet from a white screen one foot square; suppose another much larger screen, placed twenty feet from the candle, both screens being perpendicular to a line through their centers and the candle flame. The first screen is lighted by the candle, and casts a shadow on the second screen. The shadow is two feet long and two feet wide, covering four square feet of surface. If the first screen be now removed, the light which passes through the square foot of surface previously filled by it now falls on the screen where the shadow was, and is spread out over four square feet of surface. The intensity of illumination (quantity of light per unit of surface) on the shadow space is, therefore, only one-fourth as great as that produced on the one foot surface at first. If the second screen had been placed thirty feet from the candle, the light which fell on the one square foot of the first screen would, on its removal, be spread over nine square feet of shadow space on the second screen, and the amount of light on each square foot would be only one-ninth of that which fell on the square foot surface at ten feet. Now, suppose that two screens, each one foot square, are placed side by side, so that one receives light only from a candle at ten feet distance, and the other receives light only from a lamp. Move the lamp until the screens are equally bright. The lamp is then found to be, say thirty feet, from its screen. If this screen were now placed ten feet from the lamp, it would evidently receive nine times as much light, hence the light-giving power of the lamp is nine times as great as that of the candle, which is expressed by saying that the lamp is a nine-candle power lamp. In the case supposed, the distances at which the lamp and the candle produce equal intensity of illumination are to each as three to one, and their candle powers are as the squares of these numbers, or as nine to one. We therefore say that the light-giving values of two sources of light are to each other as the squares of the distances at which they produce equal intensities of illumination.

A photometric standard should be of definite area and of definite temperature, since the quantity of light given off by it depends upon both. In the case of flame standards, it is not difficult to meet the first condition. The temperature of the flame depends upon the rate of consumption of the combustible, upon the composition and temperature of the air supplied to and surrounding it, upon the temperature of any objects near the flame, and upon barometric pressure. The amount of heat produced by burning a given weight of material in the flame is definite. This heat is partly used up in raising the temperature of inert gases which pass through or come in contact with the flame (nitrogen, carbonic acid gas, vapor of water, etc.), partly in raising the temperature of the matter which forms the luminous part of the flame before it burns and partly by radiation to surrounding objects. A variation in any one of these factors must cause a variation in the temperature of the flame, and therefore in the amount of light given off by it. The difficulties encountered in the determination of the proper corrections for these several influences have so far proven insurmountable. Many forms of standard have been proposed, but as yet no standard has been found which is wholly satisfactory.

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The legal standard of light in the United States and in England is the sperm candle. Its light is defined to be of one legal standard candle-power, when it is burning 120 grains of sperm per hour. Standard candles weigh about one-sixth of a pound each. They are about nine and three-quarters inches long and thirteen-sixteenths of an inch thick. They are made "exclusively of spermaceti (the product of the sperm whale), pure white and dry, having a melting point of as nearly as possible 109 degrees, and to which has been added just so much air-bleached bees-wax, having a melting point of 140 degrees, as would suffice to break the crystals of the spermaceti, the rate of combustion of 120 grains an hour being secured by a properly proportioned cotton plait serving as a wick.*

When using standard candles, the rate of combustion is determined by means of a balance on which the burning candles are mounted. The candles are usually burned in pairs, and should consume 40 grains of sperm in ten minutes. The rate of consumption varies with different candles, and with successive readings on any candle It is found by trial that the light produced by a candle is approximately proportional to the rate of burning sperm, provided twenty grains per candle be burned in not less than nine and one-half minutes, and not more than ten and one-half minutes. It is found, however, that even after corrections have been made for rate of burning, the results by single candles, and by different candles, differ from one another. Careful workers, therefore, take many readings on several candles, with the idea that the average of all the readings will be probably right. Full directions for the proper use of candles may be found in Dibdin's Practical Photometry, page 90.

Benj. F. Thomas.

BRAKES ON TROLLEY CARS.

The multitude of electrical publications is now so great, so much talent is employed by them, and so much enterprise is displayed by them, that between them all we should at least be able to get at all the important facts connected with the matters which they professedly handle. As it is their mission to disseminate knowledge, to promote investigation, to chronicle the results of investigation and experiment, and in a manner anticipate for the uninitiated the progress and development of the modern wonder, we had hoped before this to have seen something of the topic indicated by the title above. We have been waiting very patiently and looking very longingly for some solution of the perplexing problem of how to operate the brake upon the electric car, so that an electrically propelled car shall be as safe as any other, so far as the stopping of it is concerned. We have not seen that problem considered, or even enunciated by any electrical journal. Why not? It is not to be supposed that any electrical journal is ignorant of the fact that an electrically driven car upon a street railway, a trolley car, either an overhead trolley, or an underground trolley, and especially, and, for an additional reason, a car operated by a storage battery, cannot either of them, with safety to itself, be stopped as quickly as any other car of the same capacity, and running at the same speed. Instantaneous brakes can be applied to any car, they are used upon cable cars and others, but they are not used upon electric cars, and are not likely to be so used. While the safety of the public imperatively demands that a car shall be stopped as quickly as possible, the safety of the car mechanism demands that there shall be no such instantaneous stoppage, and, of course, the safety of the car is the prevailing consideration rather than the safety of the child that is caught under the front of it. If any one will take a little trip upon a trolley car, and watch the operation of the brake, he can easily get the impression that the brake is purposely designed to be applied with some deliberation, and cannot be applied in any other way. The brake cannot be put on as quickly as the current can be thrown on or off. For operating the brake a long crank is provided, and a complete revolution of the crank is required before the brake begins to bite, while the full pressure is applied by a series of ratchet movements given after. Besides this it is at least possible that in some emergencies motormen have been confused and "rattled" and have turned the crank the wrong way, and have failed to apply the brake at all. Any mechanic must see at once that the brake, in view of the emergency that it is supposed to provide for, is a slow acting affair, and if he will investigate the propelling mechanism of the car he will easily see that it is purposely made so. The armature of an electric motor, as everybody knows, is quite a heavy part of it, and, running at a high velocity, it is, of course, a powerful fly wheel, and when it is noticed that the armature, or the shaft which carries it, is geared to the axle without the possibility of slip, the whole situation is exposed. If the axle is stopped suddenly something is going to be smashed, so the slow-acting brake is a safety device for the motor.

We have been wondering for some time, why this matter has not been brought to the attention of the public, so that the real state of affairs could be generally understood, and so that the remedy might be sought in the right direction. The voluminous discussion about car fenders has not helped to promote the permanent safety of electric traction. Common sense unaided can determine that an instantaneous brake is a necessity in connection with rapid transit, and it should be insisted upon. The re arrangement of the motor mechanism by the application of friction clutches or other devices could be accomplished by many an engineer of the day, so that there is nothing impossible to be demanded. In calling attention to this matter we feel that we are promoting rather than retarding the safe and permanent establishment of the electric motor, and that we are more truly its friend than a e any of those who hesitate to tell the whole truth about it.—*American Machinist*.

Little stress has been laid on the necessity for a special brake for electric cars, for the reason that conditions make such a brake largely unnecessary. There are three ways of stopping an electric car now in use: by mechanical brake upon the wheels or axle; by simply shutting off the current, causing the armature to stop gradually; and by throwing the reversing switch, causing both motors to be transformed into generators and placing them immediately under heavy load. This last method is called an emergency brake, and it stops the car so quickly that passengers are thrown out of their seats, and from one end of the car to the other. By this method a car may be stopped under ordinary speed in half its length. By the second method, that is, by simply shutting off the current, the stop is made much more gradually as the armature ceases to revolve, and a mechanical brake is used as an auxiliary simply to help stop the armature by friction on the wheels, which are of course geared to its shaft.

It must be remembered that electric cars are much heavier than any other kind, because they carry the motors and, in addition to their weight, the cars themselves must be made proportionately stronger than others to bear them. Hence, it naturally follows that electric cars must be stopped more slowly even if they travelled no faster than others. But the danger to the motor itself is in no part a preventive of the use of either a mechanical or other kind of brake. In the earlier days, motors were not able to stand great strains, and the criticism of the Machinist would have been good. The motor armatures are made almost wholly of iron and the segments are so bound together that even an immensely rapid revolution or tremendous jarring exercised on the wheels by sliding would do no harm. The only parts of a motor possible to destroy by a brake are the gearings, and nowadays these are purposely made to stand any kind of strain, and will in reality stand almost any strain that the wheels and axles will bear and they very rarely strip.

This matter of additional brakes for cars has not seemed to railway electricians of much importance, and it has been generally supposed that present methods were sufficient for present conditions. However, there are a few men doing some work in this direction, and the results have taken three forms, viz: short circuiting devices, electro-magnetic devices, and mechanical devices acting on the axle and wheels.

In conclusion, it might be truthfully said that the American Machinist is wrong in assuming that this matter has been evaded by collusion between the electrical press and railway people. The best friends of electricity are those who pick out its weak points and hold them up for examination by the scientists in electricity. We believe the electrical press, almost without exception, is such a friend. And we believe there is not a journal in the field that would hesitate to expose any shortcoming. Electricity has done too much for the world in recent years, for its votaries to fear criticism.

EDITOR.

RIGHT IN HIS LINE.

"This trolley road is a great undertaking," remarked the garrulous citizen.

"Yes," was the reply, "I have ample reason to know that."

"Why?"

"I'm in the undertaking business myself."—*Washington Star*.

* Miller & Co., makers of standard candles. See Dibdin's Practical Photometry, page 88.

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TESTING RAILWAY CIRCUITS.

Manner in Which Ammeters and Voltmeters May be Used In the Determination of Line, Insulation and Machine Resistances.

DISCUSSION FOR PRACTICAL STATION MEN.

In electric railway work, it is often necessary to measure current, voltage and resistance. Tests must be made to find whether different circuits are properly connected. Tests should also be made occasionally to learn whether dynamos, motors, lines and other parts of the electrical equipment are in good order and are working properly. Some of these tests are simple, and may be made by anyone with a little experience. Other tests are more complicated and require much skill to give reliable results.

Measuring instruments must not be handled roughly. In the best instruments, especially portable ones, the pivots, bearings, and other working parts are made and fitted together as carefully as a watch. If the instrument is allowed to fall, or is knocked about and roughly handled, the pivots and jewel bearings are liable to become damaged, the pointer may become bent or the moving needle or coil may be loosened or moved out of place. If the instrument contains a permanent steel magnet (and most portable instruments do), the magnet is weakened so that the instrument will not measure correctly.

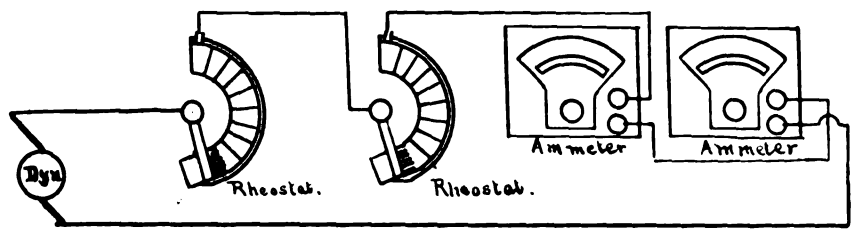

Fig. 1.

Most instruments must be leveled more or less accurately, so as to be horizontal or vertical as intended. If not leveled, the moving parts are liable to be thrown out of balance, and the friction may be increased so as to affect the readings.

Instruments must not be placed too near dynamos, motors, large masses of iron, heavy currents or other sources of strong magnetic fields. These are liable to affect the instrument permanently by changing the strength of the permanent magnet. The effect may be only temporary, making the readings too large or too small. This caution does not apply to hot-wire instruments, such as the Cardew voltmeter, nor to electro-static instruments. Outside magnetic disturbances may be detected by turning the instrument half way around and then comparing measurements in the two positions.

Instruments must not be allowed to carry more current than is indicated on the scale, or the wire will become heated so as to damage the insulation or melt the wires. For a similar reason, instruments should not be put in a hot place. Most instruments are not damaged if the connections happen to be reversed so that the current passes through them in the wrong direction. Instruments that do not contain permanent magnets will measure equally well if the current is reversed. In using voltmeters with double scales, great care must be taken not to use the wrong binding posts, and subject the low-reading coil to too high a pressure. If one intends to use the low-reading coil, he should first test with the high-resistance coil, in order to be sure the voltage is not higher than expected.

The connecting wires must be fastened securely. If a lead pulls out from the ammeter, the circuit is opened, the flash is liable to damage the instrument, and the loose end of the wire is liable to come in contact with other conductors and cause a short circuit. A loose voltmeter connection is also liable to cause a short circuit. Flexible cables are often used as temporary connecting wires for ammeters and voltmeters, because they are easier to handle than solid wires. The ends of the cables should be soldered together, or soldered to a solid terminal, so as to give a firm bearing for binding screws and so as to avoid loose ends which may cause short circuits, care must be taken not to short-circuit instruments by wires touching the cases. It is often desirable to tape the connections between the flexible leads and the permanent wires, to secure good insulation, especially in testing on cars.

The instruments should be tested occasionally to see if they are in good order. The pointers should generally come to the zero position when no current is on. An ammeter may be tested by connecting it in series with another one supposed to be correct. If the two agree at several points, when different currents are sent through them, it is probable that both are right. To be certain, one should compare it with a standard instrument that is known to be correct. The two instruments are connected in series with each other and an adjustable resistance, as suggested in Fig. 1. The current is varied and both instruments are read at the same time for each current strength. From the two sets of readings one may plot a curve from which one may obtain the correct current for any reading on the changed instrument, or one may construct a new scale or mark the proper values upon the old scale.

In calibrating voltmeters, the two instruments are connected in multiple as suggested in Fig. 2, and are connected to different points along a series of incandescent lamps or some other convenient resistance, through which current is passing. Different points are compared on both instruments, and a new scale is constructed if necessary.

Resistance may be measured by a number of methods, some of which may be used only by carefully trained experts in a quiet laboratory, free from noise, jarring, heavy currents or moving pieces of iron. Other methods may be used in a power-house, shop, car-barn, or anywhere else by persons without very extended experience or training. Only such methods as are suitable for general use will be considered.

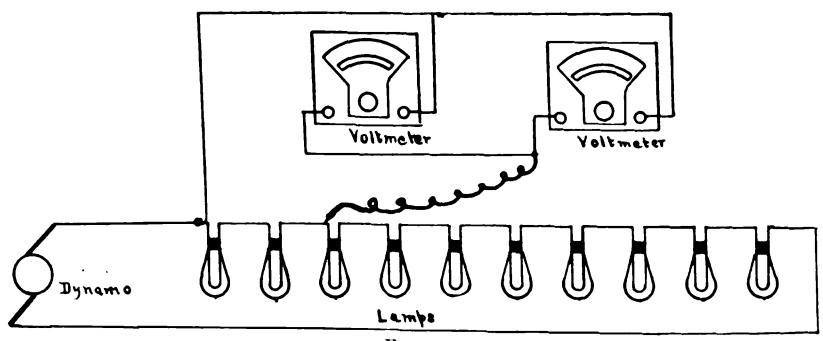

Fig. 2.

The *portable bridge*, or *testing set*, is convenient for many purposes. Such instruments are suitable for resistances between one meg-ohm (1,000,000 ohms) and 0.1, or sometimes 0.01 ohm. The battery is connected to the binding screws marked "B" or "Bat.," and the resistance to be measured is connected to those marked "X" or "Line." If the resistance is low, care must be taken that the connecting wires, or *leads*, are short and of large wire, so that their resistance will not introduce an error. If long leads are unavoidable, their resistance may be measured by connecting the further ends together and then making con-

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nections. The bridge is most sensitive and accurate, when the four arms have about the same resistance. If a resistance of about 100 ohms is being measured, one should use the arms in the ratio of 100 to 100, rather than 1 to 1. If the adjustable resistance is not divided into small enough parts, one can measure more closely by changing the ratio arms to 10 to 100, 100 to 1,000, or, if necessary, to 10 to 1,000. For measuring resistances below 100 or 200 ohms, one should use from 1 to 4 cells of battery. For higher resistances, the battery may be increased to 20 or more. The galvanometer is more sensitive as the current through the bridge is larger; but a large current heats the coils, makes the bridge incorrect, and is liable to injure it permanently. In measuring resistance of coils, the battery key must be closed several seconds before the galvanometer key, or the galvanometer may give a false deflection on account of the self-induction of the coil.

Ordinary galvanometers are more or less disturbed, if pieces of iron, magnets or currents are near. For this reason, d'Arsonval galvanometers are best. If an ordinary telephone receiver is used instead of a galvanometer, a click will be heard when the key is pressed. The click becomes fainter and fainter as the resistances are adjusted more closely.

The bridge is unsatisfactory for measuring the resistance of motors or dynamos, on account of self-induction, the resistance of the leads to the bridge, and the difficulty of getting good contacts. For measuring low resistances, the *voltmeter* and *ammeter* are often used. This method is based on Ohm's law that the resistance equals the voltage divided by the current. An ammeter is connected in series with the resistance to be measured, and a voltmeter is shunted around it, as indicated in Fig. 3; current from any convenient source is then sent through the circuit, and readings on both instruments are taken at the same time. The strength of the current should then be changed, and a second set of readings taken. The resistance, as calculated for either set of readings, should be about the same. The resistance will be larger with the larger current, if it heats the coil. Suppose in Fig. 3, that the instruments show 20 amperes and 10 volts. The resistance of the coil being measured is 10 divided by 20 equals ½ ohm.

Care should be taken to connect the voltmeter inside the main connections, unless it is intended to measure the resist-

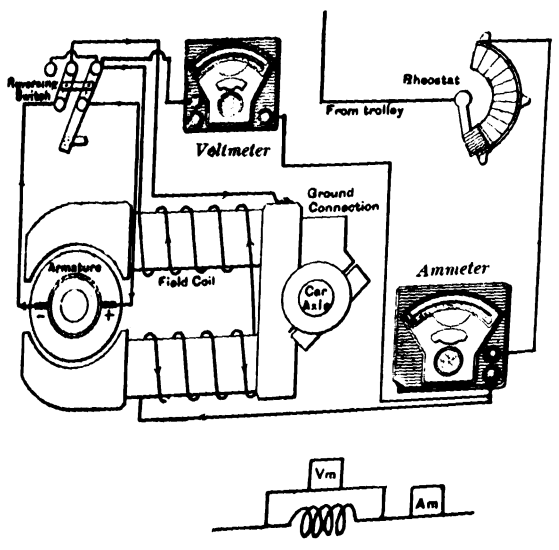

Fig. 3.

ance of these also. This method is suitable for measuring the resistance of field coils, armatures, rheostats, etc. If the voltmeter is sensitive enough to measure small fractions of a volt, the resistance of switches, circuit breakers, ammeters, buss-bars, etc., may be measured in this way.

The resistance of the line and return may be measured by an *ammeter and two voltmeters*, which have been tested and found correct, or have recently been calibrated. After all regular cars on any line are in for the night, a car is run out to different points which are to be tested; the ammeter is connected into the main circuit of the car at any convenient point, such as the canopy switch or the controller; one of the voltmeters is connected between the trolley wire and the rail; the brakes are set tightly, so that the car cannot move; the controller is turned on for a few seconds, until readings can be taken on both instruments. The motors will stand 100 amperes or more for a few minutes without damage. Readings are taken in the power-house with the other voltmeter at the same time. The difference between the two voltmeter readings equals the drop on the line and return. At one test the station

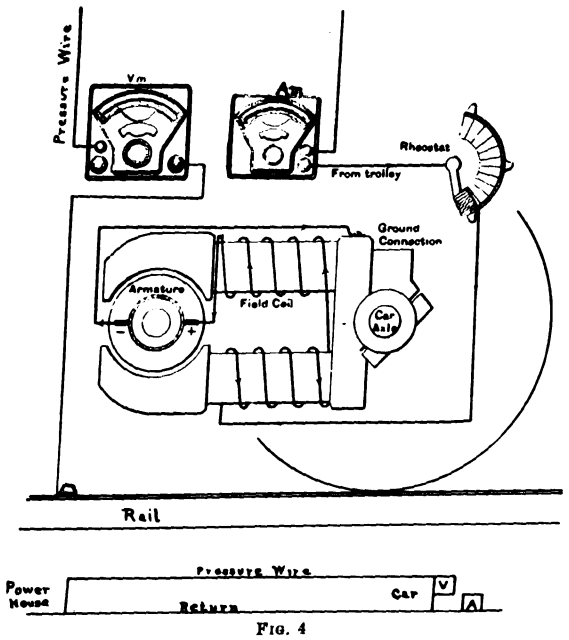

Fig. 4

voltmeter read 500 volts, while the instrument on the car read 480 volts and 80 amperes. The resistance of the line and return was therefore,

(500−480) divided by 80 = 0.25 ohm.

By having an extra wire, such as a telephone line or insulated guard wire, between the power-house and the place of the test, the drop on the line and on the return may be measured separately. Connect the extra, or "pressure wire," to the end of the feeder at the power house; connect a low-reading voltmeter between the pressure wire and the trolley wire at the car as suggested in Fig. 4; send about 100 amperes through the car as before and read both instruments. The voltage divided by the current gives the resistance of the line. In a similar way the resistance of the return may be measured by connecting the pressure wire to the track feeder at the power-house and connecting the voltmeter to the rail at the car. In a certain test of 3,000 feet of double track the instruments on the car read 80 amperes and 3.2 volts. The track resistance was therefore,

3.2 divided by 80 = 0.04 ohm.

A similar method may be used to measure comparatively high resistances, such as the insulation of a railway line. For this purpose the ammeter should measure small currents accurately. All motor and lamp circuits must be opened. Connect the ammeter into the line and connect the voltmeter between the line and the rail as shown in Fig. 5. If the line is long and the ammeter reads as low as 0.1 or even 1. ampere, it is likely there will be a readable current, caused by leakage through the the insulation. On a certain line, 28 miles long, the ammeter showed 0.2 ampere when the voltmeter read 500 volts. The insulation resistance of the line was,

500 divided by 0.2 = 2,500 ohms, or 2,500 X 28 = 70,000 ohms per mile.

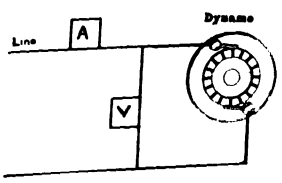

Fig 5.

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A more sensitive method for measuring high resistances, such as the insulation of lines, motors and generators, is by the use of a voltmeter of known resistance. The voltmeter is first connected across a dynamo or line upon which a constant pressure is kept up. The resistance to be measured is then connected in series with the voltmeter, as suggested in Fig. 6. Since the voltmeter and the unknown resistance being measured, are in series, the same current passes through both; and the "drop" or fall of potential, through each part varies directly as its resistance. The voltmeter shows the drop through itself; the difference between this and the total voltage is the drop through the unknown resistance. The two resistances are proportional to the drop through each one, and from the proportion it is seen that the unknown resistance divided by the voltmeter resistance equals the drop through the unknown resistance divided by the drop through the voltmeter; or, the unknown resistance equals the voltmeter resistance multiplied by the difference between the two voltmeter readings, divided by the smaller voltmeter reading.

For example, a voltmeter with a resistance of 81,000 ohms measures 500 volts when connected between the trolley and the rail. When connected between the trolley and the field coil of a motor which was disconnected from the controller it measured 5 volts. The insulation resistance between the field coil and the frame of the motor was, therefore,

81,000 X (500—5) divided 5 =8,012,000 ohms, or 8 meg-ohms.

The insulation resistance of a whole car equipment can be measured at once by connecting a voltmeter in series with the

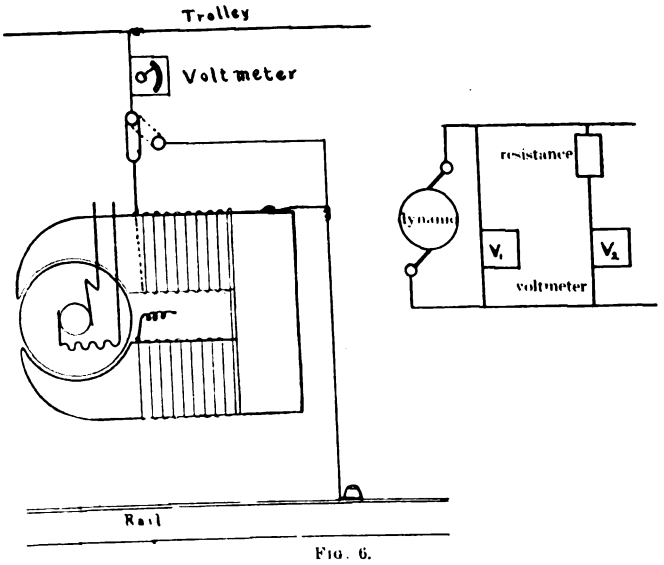

Fig. 6.

main circuit at the fuse block, canopy switch or other convenient place, and then throwing the controller on to the first point. Since the resistance of the rheostat and motor circuits is very small, compared with the voltmeter resistance, the voltmeter will indicate the entire voltage between trolley and rail. Next, open the ground connections on the motors or controller and take a reading. All the insulation between the ground and both armatures, all field coils, rheostat controller and lightning arrester is in parallel and the voltmeter is in series with it. The insulation resistance of the whole car is then calculated as in the preceding example. In a certain case, the 81,000 ohm voltmeter read 490 volts at first test and 20 at the second. The insulation resistance of the car was, therefore,

81,000 X (490—20) divided 20=81,000 X 470 divided by 20= 190,000 ohms.

This method may easily be used to measure the insulation resistance between any circuit and the ground, or between any two circuits.

By Geo. D. Shepardson.

The Sierra Nevada Mountains furnish sufficient volumes of water at heads ranging from 500 to 2,000 feet to provide nearly every town in California with all the power for electrical purposes that can be used there.

CENTRAL STATION ECONOMY.

Use of Water Meters in Reducing Coal Bills—Table of Statistics Showing Results of Tests.

Very few central station lighting or railway plants, even in our larger cities, are equipped for determining, or do in any way determine, their daily evaporation. As even in modern lighting plants of large capacity the coal bills are very frequently twenty-five per cent. of the entire operating expense, while ten per cent. is a goal rarely reached in our best stations, and fifty to sixty per cent. is not unusual in small cities giving no day service, it is evident that the question of fuel economy is most important.

Many station managers rely on the watt-hours output per pound of coal as a safe index of fuel value, but satisfactory results cannot be obtained in this way, because many errors of varying value enter to affect the total, and because some important considerations are entirely overlooked by such a method, resulting in misleading conclusions.

If we found by experiment that a certain station running at full load gave an output of one hundred watt-hours per pound of coal, we would not expect it to give the same results at light load, for while the pounds of coal per indicated horse-power might remain approximately constant, the friction load, especially if the engines drive through a line of countershafting, might increase from twenty or twenty-five per cent. to as much as fifty or even sixty per cent. of the total indicated horse-power. It is also true that most lighting companies do not know what their watt-hour output really is, and this is especially true where alternating currents are used. The writer has found by many experiments that under certain conditions, which need not be specified here, but which, by the way, are the existing conditions in most plants giving twenty-four hour service, the wattless current averages as much as thirty-five per cent. of the total output. If the watt-hours output is estimated from the station record of volts and amperes, it is, therefore, evident that the estimated or apparent watts will exceed by about fifty-four per cent. the true watts, and the watts per pound of coal will be too large by the same proportion. Of course if the record of output is obtained by recording watt meters on the station switchboard, which do not register the wattless current, this error is eliminated. It is a fact, however, that very few central stations are so equipped, that most companies do estimate their output from their ampere records, and that results are obtained which not only are false, but which are useless for comparison.

The watt-hour output method therefore introduces errors which make it inaccurate in determining fuel value.

In buying coal there are three factors which the station manager should take into account: the evaporating power, the cost per ton, and the pounds received per ton paid for. The first two are inter-dependent, as it makes little difference whether a coal evaporates five pounds of water and costs two dollars per ton or evaporates ten pounds of water and costs four dollars per ton. In fact, we would prefer to use the four dollar coal. In explanation of the third factor, attention should be called to three methods in vogue with dealers in billing coal when bought in carload lots: first, at mine weights; second, at railroad weights; third, at the marked capacity of the car. If two dealers could supply a station with coal having the same evaporative power per dollar of cost at actual weight, the method of billing as given above might give one dealer an advantage that would make a very material difference in the total cost for a given evaporative performance.

Therefore in aiming at a reduction in our coal bills we should base our estimates on the cost of evaporating a definite quantity of water rather than on the watt-hours output or the pounds of water evaporated per pound of coal. This necessitates some means of accurately weighing or measuring the boiler feed water.

Water-meters, which are now made of great accuracy and

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constancy, offer the easiest method of determining the water used. It is evident, for reasons that do not need to be specified, that a cold-water-meter inserted between the feed pump and the source of water supply would introduce sources of error, and that a hot-water meter should be used which should be inserted between the heater or purifier and the boiler. Then the use of such a meter, in connection with a platform scale for weighing coal by the wheelbarrow load will enable tests of different coals to be made like those shown in the following table:

Kind.	From	Cars	Billed Lbs.	Actual Lbs.	Lbs. Water.	Lbs Water Per Lb Coal	Cost of Coal to Evaporate 1,000 Cubic ft. of Water.
No. 1 Slack.....	A	5	188,200	188,200	1,207,090	6.41	$ 8.49
No. 2 Nut Mixture..	B	7	292,150	287,700	1,518,651	5.28	9.43
No. 3 Nut Mixture..	C	5	288,000	293,000	1,631.372	5.56	7.91
No. 4 Nut Mixture..	C	5	192,000	224,500	1,268,344	5.65	7.06¾
No. 5 Screened Nut.	C	5	210,000	207,500	1,156,543	5.57	9 15
No. 6 Mine Run.....	C	5	200,000	188,800	1,182,999	6.26	9.21
No. 7 Mine Run....	D	3	115,600	112,700	760,135	6.74	7.81
No. 8 Nut Mixture..	E	4	133,500	132,600	652,255	4.94	10.03

A glance at this table, made up from actual tests, shows that the number of heat units per pound of coal, which an expert engineer might determine, or the pounds of water evaporated per pound of combustible, under the favorable conditions of a competitive test, are not the only things to be considered in determining what coal to use.

After tests of different coals have been made, and one kind adopted for regular use, the water meter will be found useful in many ways as a check not only on the quality of the coal, but on the temperature of the feed water, the condition of boilers and brickwork, the draft, and in other ways that will suggest themselves; for changes in any of these conditions will affect both the pounds of water per pound of coal and the cost to evaporate a cubic foot of water, and would at once bring the change to the attention of the watchful manager or superintendent.

There are few stations where the intelligent use of an accurate water-meter would not save its cost several times over each year.

W. F. White.

"AS ITHERS SEE US."

It has often been said that the field of technical electrical journalism is over-crowded. However true this may be, there will always be room for a technical journal of the scope and merit of The Electrical Journal, of Chicago, which is just received. In its technical and non-technical articles, and in the quality of its illustrations, it is a peer of any of the older journals, and in many respects it sets a pace which some of them will have difficulty in following. Apparently the editors of The Electrical Journal recognize the fact that the science of electricity has passed the astrological era, and its pages contain much which is of interest to the student and layman, as well as to the purely technical electrician. As a supplement to the current number, an excellent portrait of the late Dr. Joseph Henry, the discoverer of the laws of the electro-magnet, is given. Its staff of editors comprises Henry S. Carhart, LL. D., William A. Anthony, Ph. B., Benjamin L. Thomas, Ph. D., William J. Herdman, Ph. B., M. D.; Dugald C. Jackson, C. E., with J. Allan Hornsby as managing editor.—*Rochester Democrat and Chronicle.*

TIME'S EMBLEM.

Time's emblem has an hour glass been,
But it's proved an awful slow one;
It ought to have been a cable car,
For that will stop for no one.—*Exchange.*

Not so; the hour glass moves along
Too constant, slow and steady,
While the cable neither goes nor stops
Until it's good and ready.

But the trolley car! Aye, that's the thing!
True emblem of Time's flight!
It's rapid, smooth and even speed
Steals on us like the night.

A STORY WITHOUT WORDS.

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STREET CAR PROPULSION.

Economy of Various Forms of Motors--Methods of Obtaining Variable Speeds with Least Waste of Power.

In the operation of electric cars, it is well understood that benefits of the high efficiency of the electric motor are in great measure lost, because the motor does not, in general, run at its most efficient speed. The desirability of running the motor continuously at its best speed, and controlling the speed of the car by a variable gearing, has long been recognized, and numerous attempts have been made to devise such a gearing that should stand the wear and tear of street car service.

The ideal method of obtaining variable speed would be to drive the motor from a circuit whose voltage could be varied as in the system proposed by H. Ward Leonard, or by varying the counter E. M. F. of the motor as was done by Sprague, by varying the strength of the field magnets. The H. Ward Leonard system is a costly outfit, and it is impossible by varying the strength of field to obtain the necessary range of speed.

It was not my object to discuss here the electrical methods of speed control, but rather to consider the problem of obtaining a variable speed on the car from a constant speed motor. Any system of gearings for varying the speed must, to meet with favor, be simple, durable and certain in action, and must operate without waste of power. It should also vary the speed from zero to the maximum, by a continuous gradation. Many of the methods that have been proposed are faulty because of their inefficiency. Of this class are all the plans for varying the speed by means of friction devices. These are no better than to vary the speed of the motor itself in the usual way by introducing a resistance into the circuit. In this case energy is wasted in heating the resistance. In the former case, the same energy is wasted in heating the friction clutch. To fully understand this, it is only necessary to consider that in starting a car and bringing it up to speed, at least as great a "torque" is required as to maintain its speed after full speed is reached. During all the time, therefore, that the car is coming up to speed, the motor is exerting more than its normal force, while running at full speed. It is, therefore, delivering more than its rated power, of which only a fraction is used in propelling the car, the remainder being consumed in heating the clutch.

Suppose, for instance, the car were running at only one-fourth the speed it will have acquired when the clutch ceases to slip, one-fourth of the energy delivered by the motor is then imparted to the car, and three-fourths to the friction clutch.

A liquid transmission has been tried where a pump is attached to the electric motor and a liquid motor to the car axle, the varying speed being obtained by allowing part of the liquid put in motion by the pump to pass by the liquid motor through a valve by which its amount could be controlled. A moment's reflection will show that this is only a sort of liquid friction clutch, and that it is open to the same objection. It is plain that the pressure at the by-pass valve must be the same as at the motor, and that the work done at each must be proportional to the amount of liquid passing through it. Where the car is being propelled at one-fourth speed, one-fourth of the work done by the electric motor is expended upon the car axle, and three-fourths upon the liquid as it is forced through the by-pass valve. This latter simply goes to heat up the liquid and is wasted energy. It is plain that there is nothing gained by any such device. With the motors as they are now used, themselves varying in speed, the electrical energy, at slow speed, is expended partiy upon the motor usefully, and partly in the starting rheostat wastefully. With the motor and variable gear, as has been described, the motion of the constant speed motor being transmitted to the car axle through a friction clutch or any equivalent, the electric energy is all expended upon the motor, but the energy of the motor is only partially transmitted to the car axle except at full speed.

Any device to fulfill the requirement must take from the line, barring the inevitable losses of transformation, only the power applied to the car axle. As the motor is only efficient when running at full speed, the variation of speed must be obtained by a variable gearing that does not consume power except in transmission. The difficulty has been to find such a gearing that would stand the rough usage of street railway service. As an example of the kind of gearing required, though not as a practical solution of the problem, the motion of the motor might be transmitted to the axle through a pair of cones, the variable speed being obtained by shifting a belt.

A few years ago a liquid transmitter was proposed, in which, as I remember it, a pump was placed upon the shaft of the electric motor and three liquid motors of different capacities were placed upon the car axle. These motors could be used singly or in pairs or all three together, giving seven different speeds. This plan is entirely correct in theory: it is only a question how it would work out in practice. It has the disadvantage that the speed is varied by steps and not continuously. In another device, recently proposed, four reciprocating pumps are arranged radially at angles of 90 degrees with each other, and actuated from the same crank upon the shaft of the electric motor. This crank has a variable throw, adjustable while in motion, from one and one-half inches on one side, to one and one-half inches on the other side of the center. When the throw is greatest, the pumps deliver the largest quantity of liquid and impart to the car axle the highest speed. When the crank pin is at the center, no liquid is delivered and the car stops. With the crank pin transferred to the opposite side of the center, the motion of the car is reversed. The speed may therefore, be varied from full speed in one direction to full speed in the opposite direction, by a continuous gradation, the electric motor continuing to run in one direction at full speed. This device is theoretically an ideal arrangement. It uses just the power needed at all speeds; it provides for changes of speed through all possible gradations from zero to the maximum, and the same operation carried far enough, reverses the car. Moreover, when the car is at full speed, if the strokes be shortened, the speed of the electric motor is increased, and it becomes a generator restoring current to the line, and acting as a very efficient brake to reduce the speed of the car.

If the crank pin be brought to the center the pistons are held stationary, no liquid can pass through the pump, consequently the car axle cannot revolve and the car must be brought to rest. The motorman controls the entire movement of the car, starting, applying the brake, and stopping, by one handle, and by a means which makes the control absolute. He runs at any speed he likes within the limits for which the machinery is constructed; he diminishes and increases the speed at pleasure, having always a definite speed for each position of the controlling handle, he brings the car quickly to a full stop by simply bringing the handle to the zero position. Indeed so definite might be the speed of a high efficiency shunt motor or a polyphase induction motor, that the dial of the controlling handle might be marked in miles per hour from zero up.

I say this is theoretically an ideal arrangement. Experiment must decide how it will work in practice. One difficulty occurs to me. Since there are four cylinders there is a constant pressure, and work constantly being done at all positions of the crank pin. To move the crank pin out from the center must, therefore, require considerable force. An idea of the amount of force may be obtained by considering that if the electric motor were stopped with the crank pin at the center, to move it outward would displace the pistons, force the liquid round through the liquid motors, and turn the car axle. The same work must be done to move the crank pin outward when the motor is in motion. Can this work be done by the motorman, as rapidly as it would need to to be done to control the car? Will a loose crank pin, controlled by a rack and pinion, stand the service that it must perform? Experience will tell.

Wm. A. Anthony

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ELECTRIC FORCE WITHOUT STEAM.

If the German inventor, Dr. Borchers, has not solved the long-standing problem how to convert the heat energy of fuel into electric force without the intervention of steam he appears to have taken a long step towards the achievement of that highly-desirable result. He is reported to have devised a new form of electric battery, the current in which is generated by the conversion of hydro-carbons and carbonic oxide into carbonic acid, or practically the same reaction that is produced in the combustion of coal. If this process really be accomplished the energy with which the oxygen combines with the fuel material can be compared directly in the two cases, and a great economy in the use of the force ought to be obtainable by dispensing with the steam engine.

It is claimed that Borchers' battery has delivered in available form three times as much energy as can be obtained from the same quantity of fuel when used for the production of steam in the most economical manner known, and that at no time has it delivered less than twice as much. It seems capable of trebling the effective value of the coal used, and doubles that value under the least favorable circumstances of trial thus far. In other words, it makes one ton of fuel do the work that hitherto has taken not less than two tons to accomplish a stated result, and promises even a greater economy in the employment of fuel for the evolution of power into a form which can be directly applied by man for the turning of machinery and the production of warmth and light.

If there be no mistake about this announcement it will not be many years before the steam boiler is entirely abandoned as too expensive and cumbrous a means of obtaining power for the various uses wanted in the factory and workshop, and in the private dwelling. The new conditions, which promise to come along before the new century is far under way, will be a vast improvement upon those of the present, and the folks who are privileged to live then will wonder that their forefathers lived for so long in what the later ones may deem to be but a small remove from the old-time barbarism, if not from the primitive savagery of the human race.—*Chicago Tribune.*

A FORGELESS SMITHY.

The only blacksmith shop in the country without a forge is said to be operated by William Patterson at Niagara Falls. The great cataract supplies the power. The decomposition of water by the electric current is an old and well-known phenomenon but the heating of the negative electrode by the ignition of the liberated hydrogen gas has only recently attracted the attention of those interested in the electric heating, welding by and forging. The first method of heating a piece of metal the liquid forge was to connect a lead plate to the positive wire and a pair of tongs to the negative. Then by grasping with the tongs the metal to be heated and immersing it in the vessel containing the positive electrode and a good connecting solution of dilute sulphuric acid of soda, the metals will begin to increase in temperature, and if the operation is continued long enough will melt. All the time it is increasing in temperature it is in view of the operator, and can be withdrawn when the desired heat is obtained. The above method of electric heating by complete immersion requires considerable current, and this led to the perfecting of the method now used, of holding the metal to be heated in contact with the surface of the liquid and as the hydrogen gas is given off it is ignited directly in contact with the metal, which absorbs the heat generated. The time required to heat iron varies. It takes eight seconds for a piece of iron one-quarter inch square cross section, to one minute for a piece of one-inch square; the latter requires 16 amperes at 220 volts which cost, it is claimed, is less than a quarter of a cent for current. The cost of preparing a horse shoe with a coal forge, with coal at $5 per ton, is 5.85 cents; with the electric forge, and current at 15 cents per 1000 watt hours, it is 2.32 cents.—*The Railway Review.*

NEW SUBMARINE TORPEDO.

A telegram from Oakland, Cal., says that Charles F. McDermott is perfecting an electric sub-marine torpedo, the invention of Dr. Gross, of Chicago, which he says will ultimately put an end to marine warfare.

With his torpedo, he says, a few men could keep off the combined navies of the world. The torpedo will be completed within a week. It will be taken to Goat Island, where a secret experiment will be made. An old iron hulk is to be floated and the torpedo will be sent down below the surface of the water on its errand of destruction. Mr. McDermott is confident that the new invention will instantly scatter and sink the hulk. He says that no warship, however strong and formidable, can survive a shock from his torpedo. About the 1st of September a public exhibition will be given. By the use of electricity, with combinations of powerful explosives. Mr. McDermott says he can destroy the stanchest of vessels.

Dr. Gross, the inventor, recently manufactured and patented a new explosive more powerful than dynamite. He made arrangements to sell it to China, to be used in the war with Japan. With his explosive he crossed the Pacific, but his secret had been divulged and the Japanese Government notified the Federal authorities at Washington, who enjoined him from making further negotiations with the Chinese Government. The same explosive is to be used in the torpedo.

TRIED TO ELECTROCUTE A SNAKE.

A snake story comes from Rochester, Pa., which stamps the quality of the "Jersey lightning" dispensed in that locality. A house snake four feet two inches in length was captured near the residence of C. P. Brobeck. Instead of killing the reptile at once it was decided to try the effect of electricity. It was taken to the electric light power-house and turned over to the electrician for execution. A wire was attached to the mouth of his snakeship and one to his tail. This was not accomplished without much difficulty, as the snake wriggled desperately and struck savagely.

When all was arranged the full force of the electric current was turned on to the reptile. How many thousand volts were used is not stated, but the electrician said it was sufficient instantly to kill a dozen men. The snake twisted and turned and then stretched out stiff. The chief electrician said he was dead and ordered the current turned off.

The apparently dead body of the reptile was then placed in the sun and to the amazement of the spectators began to crawl off. Again it was caught and the current applied, but with no better result, and finally it was killed in the good old-fashioned way—with a club.

LENGTHS OF ARCS ON 500 VOLTS.

To give some reliable information in regard to the distance of contact on cut-outs and knife switches, the underwriters of Chicago have made some experiments, and give the following data:

Amperes.	Maximum length at which arcing occurred.	Minimum length at which no arc was observed.	Safe lengths.
10	¼ inch	½ inch	1 inch
20	½ "	¾ "	2 "
30	2 "	2 "	2¼ "
40	2 "	2¼ "	3⅛ "
50	2¼ "	2½ "	3½ "
60	3 "	3¼ "	3⅞ "
70	3 "	3½ "	4 "
80	3½ "	3½ "	4⅛ "
90	3½ "	3⅞ "	4⅜ "
100	3⅞ "	4 "	4½ "

The above table does not require explanation, and the figures are simply the result of experiments. Good judgment and care will point out the use to which the figures may be put by those who are installing apparatus.

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A Correction.

The article by Prof. Jackson on the Choice of Transformers, which was published in the issue for July 15, contained a typographical error which has possibly been misleading to some readers. The transformers which are compared with each other are numbers four and nine, as given in the table instead of numbers three and four.

* * *

Death by Electricity.

Prof. Anthony's arraignment of electrocution, in a recent editorial in this JOURNAL, is from the standpoint of one who is evidently a disbeliever in capital punishment, and, as a true lover of the beautiful, exhibited in physical phenomena, deprecates what he regards as an unrighteous use of nature's forces. I must confess that I find myself somewhat in accord with his views, but, on the other hand, the facts seem to show that there is no foundation whatever for the scepticism that prevails in some quarters as to the reality of death from electricity when it is employed for this purpose.

The adoption by the State of New York of electrocution in the place of hanging, as the legal mode of capital punishment, was in response to the dictates of that spirit in which justice is tempered by mercy. The change was made in the face of much bitter and determined opposition, largely created and sustained by certain influential manufacturers of electrical machinery. Their actions seemed to be prompted by the unfounded assumption that the use of their dynamos for such a purpose would demonstrate that the electric currents they generated were dangerous to life and so would affect their sales.

The claims made for electrocution are that death by means of it is sure, speedy and painless. If these claims are sound, granting that the taking of human life is a prerogative of human government, this method of destroying it is for the criminal, the officers charged with the unpleasant duty, and the spectators, as well, far less distressing and objectionable in incidents and details, than any form of execution hitherto devised.

That electricity is a sure and speedy cause of death when employed after the manner adopted at Sing Sing and Auburn prisons, there can be no question. Here it is the deliberate purpose to so arrange the conductors as to cause the entire energy of the current to traverse the vital centers of the body, and this in quantity sufficient, many times over, to destroy their intimate texture beyond all possibility of recovery. There is no doubt, in these electrocutions, but that the vital centers receive the stroke, and that it does there the work intended. The electrodes are so placed that the brain and upper part of the spinal cord, which is the seat of control for respiration and circulation, cannot escape. And although it is possible, after a body has received for some seconds, a lethal dose of electricity in this manner, for the heart to beat and the muscles of the limbs to contract for a brief period thereafter, if pinched or cut, there is no evidence in this that the main vital centers could, by any procedure whatever, be reanimated. The parts of the body which have, in any reported case of electrocution, given these flickering signs of life have not been in the direct line of the current so that their independent power of action is for the moment retained a brief show of resistance on the skirmish line, which has not yet discovered that the main army has suffered defeat.

The enormous amount of electric energy expended on certain selected portions of the body during an electrocution, aggregating during the period of application from fifteen to twenty horse power, is capable of putting an end to life in a variety of ways, one or more of which may operate in any individual case. The electric force is in a great measure transformed during its passage through the body into heat with its destructive action, chemical force resulting in electrolysis and recombination of atoms, mechanical forces with their attendant shock, and physiological forces abnormal in violence and degree of action. In consequence of these sudden transformations of energy, blood vessels are ruptured, cellular structures in blood and tissues are disintegrated, and the conditions upon which vital action depend are irreparably changed. The changes are largely molecular and oftentimes even the microscope fails to reveal gross lesions. The post-mortem appearances differ in individual cases, as should be expected. The extreme muscular contraction that pervades the entire body the instant the current is applied, not infrequently results in a rupture of the blood vessels in the brain, lungs or liver, but this is not invariably the case, nor is it essential to death, since the other causes are ample to effect this.

Accidental contacts with electric currents, upon which a pressure is maintained as great or even greater than that employed in electrocutions, are seldom attended with conditions such as surround the criminal when placed in the electrocution chair. The contacts are usually poor, the body is not the only course for the current and the resistance is enormously high. The quantity of electric energy expended upon the tissues of the body, in all probability, is but a small fraction of what would be used in an electrocution, and moreover it is erratically distributed, seldom reaching vital centers. It is not often therefore that the victim of an accidental shock of electricity receives a lethal dose, and resuscitation is often possible if proper measures are promptly made use of to that end.

In order to prove the painlessness of electrocution, it is only necessary to remember that electric waves travel with the velocity of light, 186,000 miles per second, while sensory impressions are transmitted along the human nerves at a rate not to exceed 100 feet per second. No sensation whatever of a painful nature, except that of expectancy and apprehension, could be experienced by one who received a shock of sufficient severity to cause death.

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The Dividend Question. III.

The value of residence lighting to an electric company is one which presents itself again and again to the manager of the average electric light station, and it is a question which deserves his attention. If an electric company is to secure for itself all possible popularity as a lighting corporation and to compete on equal terms with its competitor, the gas company, it must enter residences and places of business with equal readiness and on equal terms. It is fully understood that properly managed gas companies make a goodly profit from residence lighting, and there is no reason why electric companies of fair size should not have the same success when well handled. Residence business can be profitably done only upon a meter basis, and, in fact, there is little electric lighting business to the highest success of which the meter is not essential. Where residence lighting is attempted, current must be supplied continuously during the night in order to give satisfaction to the users, and for the best satisfaction and largest ultimate income from the residence lighting the current supply should be continuous throughout the twenty-four hours. To make this pay, the greatest care must be given to the encouragement of a day load. It is possible to work up a profitable day load in nearly every town of more than ten thousand inhabitants, and, indeed, in some smaller towns, but energy and business sagacity are essential to success.

The various purposes, besides light and power, for which electric current is used, and from which a profitable day load may be built up, are well known, but too few electric stations take advantage of them. Too few station managers, for instance, place before their customers a statement of the cleanliness, convenience and other advantages of electric flat irons, electric curling irons, electric plate warmers, etc. Were the advantages of these devices placed before the public eye by the electric light companies with the same persistence and energy with which gas companies are wont to push devices for increasing the legitimate consumption of gas, a marked difference in the balance sheets of many electric companies would be observable. As an instance of the possibilities of such devices, reference may be made to the least generally useful of those mentioned above, *i. e.* the electric curling iron. There is scarcely a dry goods store or other establishment employing young women clerks which could not be readily brought to place one or more electric curling irons in the employes' cloak room for the purpose of decreasing the fire risk. Young women employes usually insist on using curling irons, and it is often to their employer's advantage for them to do so, but the use of gas or oil lamps (which must be lighted by matches) for heating the irons is a decided addition to the fire risk that nearly every store owner would gladly remove. In one of the largest American telephone exchanges, a number of electric curling irons are amongst the permanent fixtures in the dressing room of the women employes, and they are considered an excellent investment on account of their reduction of the fire risk.

Much of the slowness with which many convenient electric devices have been introduced on the circuits of electric light companies may be laid to the manufacturer. Who, for instance, has advertised his electric plate warmer as the Welsbach gas light has been advertised? Who has flooded the central stations with electric flat-iron literature to be distributed amongst consumers, as the gas companies have been flooded by gas engine and gas stove literature? The manufacturer who begins such a vigorous policy for advertising his convenient electric devices will reap a large reward, and the station manager who makes the best use of such advertising will add in a large measure to the profits earned by his plant.

* * *

Telephone subscribers who object to the rates which they are obliged to pay, might move to Boone, Iowa, where a free service is in vogue.

Patent Office Methods.

In a recent interview, Mr. Charles F. Brush is quoted in part as follows: "I have no doubt that the heads of the patent office are honest, but I have had a number of experiences which lead me to believe that the subordinates sometimes allow important information to leak out."

This is a very carefully worded and conservative utterance from a man who has been in business with the patent office for many years, and nearly all of whose inventions have been earned at the end of costly and persistently fought suits. Mr. Brush does not say so, but there is no doubt in the minds of a very large number of well informed people that most of the 200 suits, of which Mr. Brush speaks in another part of the same interview, grew out of, or were made possible, by gross incompetence or worse in the patent office.

Quoting Mr. Brush again, the interviewer says: "I have applied for patents again and again, only to find interferences filed before they were granted, and it is only through my great care in keeping records of my work that I have been able to secure a number of my inventions."

Millions of dollars have been spent by those owning and defending electrical patents, and millions more have been lost to the business because there is a well-grounded and justifiable belief, in financial centers, that the purchaser of an electrical patent becomes the owner of a most debatable law suit. Two years ago, one of the well known inventors in this field wrote for publication the statement that he had had an application for one of his patents before the department for two years, and was unable to have it acted on until he solicited and secured the interest of a United States senator, who got the application passed on within two days thereafter and the patent issued.

It seems to us that the time has come for the electrical people to take this matter up, and get it heard in high places. Past experience of patent office methods has demonstrated that the department is run in any but a business way; that it is a far more difficult thing to get an application acted on, than to enter an interference that will practically stop the issue of a patent, and that it is the easiest possible thing to lose one's application among the cobwebs and dust that have accumulated there for lo! these many years.

There ought to be an investigation by Congress, if there are enough men in Congress who are free to make a fair investigation. We believe the patent office ought to be untouched by politics, but we also believe that there are many fossils there who ought to be in the Smithsonian Institution, and we believe also that there are dishonest men there who are a constant menace to the peace and prosperity of the electrical business.

Let us get them out—fossils and sharks.

* * *

New Era for Travelers.

The combination between the Westinghouse Company and the Baldwin Locomotive Works, for the manufacture of electric locomotives is almost the revelation of prophecy concerning electric traction for long distances.

The official reasons for the alliance, given by the contracting parties are pointed: the Westinghouse people say there will be no difficulty in building machinery to haul cars at 100 or 150 miles an hour, if rolling stock can be built to bear the tremendous strain. The Baldwin people say there will be no difficulty in building such rolling stock.

These two questions settled, and on so high authority, we may safely assume that they are settled, the considerations of track, power supply, etc., are only questions for the mechanics to labor with.

The greatest drawback to the almost immediate adoption of electric railway service on through lines, is the tremendous expense involved in the discarding of the present expensive steam rolling stock and the substitution of electric locomotives. Times are growing better, however, and the railway companies will shortly be in better financial shape than for a long time past. Moreover, when people can travel as rapidly as the new

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era promises, the earnings will be greater, for the travel will be greater. People who now go to New York from Chicago once in three months, and dread the long day and night of journeying, will go much oftener when they can go to bed in one city and breakfast in the other. The handling of fresh market products will be greatly increased also, and this too will mean greatly increased refrigerator car and express service. So that taking all things into consideration, there would seem to be promise of compensation even to the railroads for the changes necessitated, and thus this most serious obstacle of all is removed or in course of removal.

Naturally suburban traffic will utilize the new power first, and gradually it will be extended all along the line.

This is a fast age. Its rapidity is largely due to electricity. Beginning with the advent of the telegraph in the middle of the century, and the almost instantaneous transmission of intelligence, let us add one more garland to the laurel wreath that crowns our century, by almost annihilating the time that has heretofore been devoted to travel. People never travel on the cars for the pleasure there is in such travel, especially when they know they must be subjected to the annoyances of dirt, smoke, etc., incident to steam power. They travel for what there is at their journey's end, and are glad when the journey is over. The same thing used to be true of street car travel, but when electricity was substituted, people began to ride for pleasure. May we not predict the same concerning long distance journeying?

* * *

Again the Storage Battery.

The Fourth Avenue Horse Car line of New York City is to again test the storage battery for traction purposes. The arrangements are all completed. The Electric Storage Battery Company of Philadelphia will make tests with a new chloride accumulator, of French make, for which the Company has the American rights. In the event of success, the Fourth and Second Avenue lines will use the new system, beginning October first.

To an interviewer for the Philadelphia Times Mr. W. W. Gibbs, president of the Electric Storage Battery Company, said:

"This method of operating street railway cars, which is new in this country, will, I am convinced, completely revolutionize the business throughout the world. It is no longer an experiment; it has passed that stage, for the cars are now running successfully in Paris. The French Electric Storage Battery Company, which is controlled by the Rothschilds, has conducted a series of experiments in this direction, and is now satisfied it has the perfect storage battery car. We have the right to use its patents and improvements, consequently it will be unnecessary for us to conduct costly experiments, but to simply demonstrate the entire practicability of the scheme. This, we believe we can do, and if we can, it means the early abandonment of the overhead and underground trolley systems."

Those who remember so far back—and it seems almost ages, when considered in the light of electrical progress—will recall the fact that the Fourth Avenue line of New York made the tests with the Julien Battery, which resulted in partial failure, and in the costly litigation which has hung like a pall over the storage battery down to the present time.

* * *

Wellington Adams' Schemes.

Dr. Wellington Adams' St. Louis-Chicago air line railroad will not be built, but those who put their money into it may rest assured that the versatile inventor will be around soon with a proposition to give them the value in stock in some other corporation—only a little more money for preliminaries and new stock certificates then the same old thing with a new name and the same result—money and experience will be exchanged—Dr. Adams, of course, taking the money and the good people will have the experience.

It would seem to one who has been a pretty close observer of St. Louis experiences, that one or two or at most three experiences of the same kind with the same people would be sufficient. Those who have had an abiding faith in Dr. Adams and his schemes, will have no trouble in digging out from their archives, Pan Telephone stock, Brown Telephone stock, Adams Electric Elevated stock, and after they have mused for a while on the old saw about a fool and his money, they may put all these stocks carefully away again, wrapped up in nice certificates of St. Louis-Chicago Electric stock. It is too bad that the whole bundle won't bring enough to enable the owner to hire a guardian to protect him in the future.

* * *

The British and Niagara.

The startling news comes from over the border that a company of English capitalists has been formed to utilize the power of Niagara on the Canadian side, and the note is added that the plans in prospective promise a greatly reduced cost for the same efficiency that obtains in the American venture.

If anything were required to demonstrate the impudence and arrogance of our friends, the English, this news would be sufficient for the purpose.

Several years ago Col. North, at the head of an English concern, obtained an option on the Canadian shore at points that would admit of a control of the situation. Not a single step was taken, however, to build a plant or to demonstrate long distance transmission, or indeed to determine whether Niagara could be utilized. The British were quite willing that some one else should do the experimenting. After this is all done and the gigantic plans are demonstrated to be almost superhuman achievement, the British serve notice that they shall do the same thing, only much better.

* * *

A Connecticut "Yankee" has devised an electric tricycle which is said to be quite practical, so far, at least, as could be judged by a small model exhibited, but the device itself is'nt a circumstance to the plan that he suggested as a means to raise the money to build a working machine. Calling a public meeting of the citizens of the town, he suggested that 100 of them pay in $10 each towards meeting the expense, and promised them that if the machine proved practical he would start a manufactory in the town to build them. Sam Slick himself never devised a smoother scheme than that.

As soon as the people of Brooklyn can decide what they want in the matter of trolley service, they will probably be able to get it. Up to date they have asked for rapid transit, then protested against the number of accidents; they then passed an ordinance to reduce the speed of cars. Now the business men and merchants are clamoring for quicker time again. In the meantime, they have indicted everybody and everything, including that bodyless and soulless institution, the railway corporation, for all the accidents that have occurred. Can it be that Brooklyn needs a guardian?

If the Cincinnati street railway companies are able to manipulate the Board of Aldermen the same as the Philadelphia roads are said to have done, they may be able to indefinitely postpone the threatened action of the Board looking to the placing of the trolley wires underground. If, however, the aldermanic figure is as high in Cincinnati as it is reported to be in Philadelphia, the companies had better bury their wires at once and declare a dividend out of the balance that will remain on hand.

The Fire Commissioners of New York have authorized the employment of an expert to superintend the stringing of wires in buildings, and they have asked the board of estimate and apportionment to waive the usual civil service examination which such employes are required to undergo. Is it possible that New York has no expert electricians who can pass the usual civil service examination?

The representative of an electric lighting company in Pennsylvania, who solicited the kindly offices of a public official and in return offered him a number of free lights only to have his offer indignantly declined, must have been dumfounded. He

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had probably been reading about the Philadelphia aldermen and judged that all public officials were moulded in the same pattern.

Competition is commonly supposed to be the life of trade, but in Boone, Ia., where a rivalry between telephone companies has brought about free service, it will probably be demonstrated that "circumstances alter cases," and that there is a point where the "life" will not only be sapped out of the competition, but out of the competitors as well.

Minneapolis has at last fixed a value on franchises, and they will be assessed hereafter just as though they were real property. Railway franchises are rated at $100,000.00. Will some of our street railway promoters rise and say whether these figures correspond with the usual aldermanic values?

Life insurance companies are apparently not as much alive to their opportunities as are their brethren, the fire underwriters. If they were, an advance in rates would long ago have been announced, and in extenuation the deadly character of the overhead trolley would have been pointed out.

It will perhaps be a little disappointing to some people to learn that the "unsightly trolley" is not after all, a wholly unmixed evil. It has been ascertained by some one that where trolley wires are strung, the liability to damage from lightning is materially decreased.

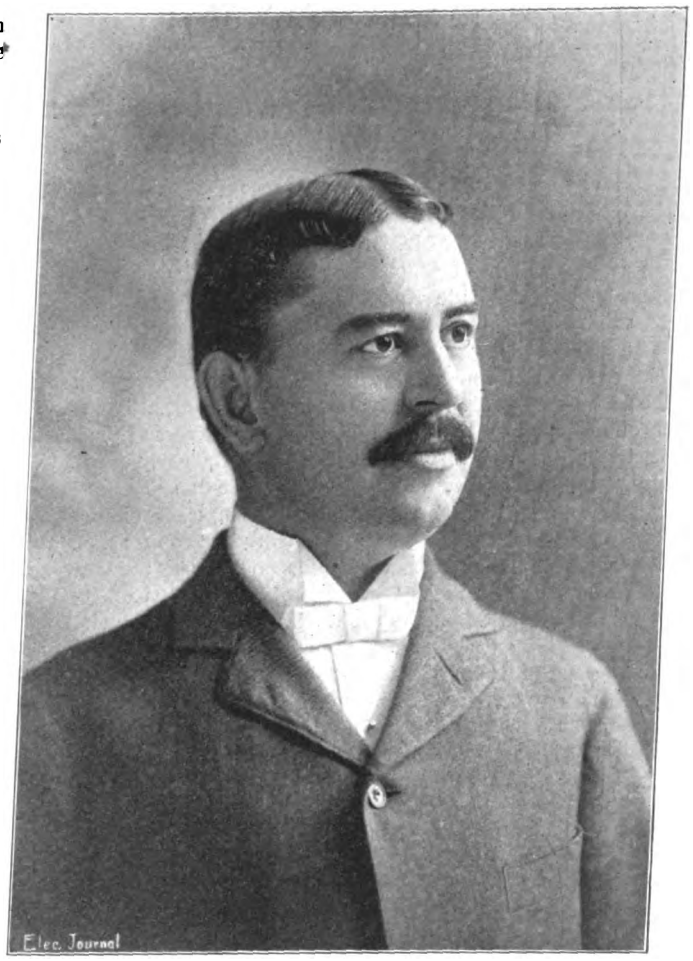
If the towing of canal boats by electricity, as is now projected for the Erie canal, had been in vogue fifty years ago, James A. Garfield might never have occupied the Presidential chair. Part of his early training was driving a pair of canal mules.

They are to build a trolley to the "Garden of the Gods." We always knew the trolley was "fit for the gods." Now let us hear no more grumbling from ordinary mortals.

The Baldwin Locomotive Works and the Westinghouse Company will demonstrate once again the truth of the old adage that "in union there is strength."

TESLA'S AWFUL DOOM.

Our readers will be grieved to learn, on the authority of Mrs. Bloomfield Moore, in the New Science Review that Mr. Tesla is in a very awkward position. It is a number of days, says this gifted woman, since Tesla crossed the border line of the circle in which other electricians are working, but he still remains in the inter-atomic field of research, unmindful of the triple conditions that govern electricity in the relation which it sustains to the first order of the "luminous." This is sad enough, but we have yet to tell the worst. It appears that by reason of Tesla's wicked neglect of Keely's system of resonance he has missed the chance of hobnobbing with electrical phenomena in the sympathetic field, and is standing on a bridge which connects the primary two-thirds of the electric stream—the sub-dominant current with the dominant. What a fearsome post is his! But the consequences of his folly will still pursue him, and even though he may hook on to the dominant, he will be subserved to the terrestrial neutral far in the rear of sympathetic union to radiating celestial outreach, the connecting link of which exists in the inter-luminous. Mrs. Moore says, further, that even in the event of Tesla's salvation, he will not have reached the compound inter-etheric. If such be the case, we should advise Mr. Tesla to climb down at once from his supra-dominant hypo-luminous outreachment, and no longer seek to attain the inter-atomic realm, but to content himself with hard pan. The sting of Mrs. Moore is, however, in her—well, our readers will understand. Given a prompt cash settlement, and Keely will plank down all his secrets, and tell us how we may make a 10,000 ton ship float like a gossamer in the summer breeze. (Our readers will kindly take notice that this last poetic vein is our own, not Mrs. Moore's.) Failing this settlement they will die with Keely. The cosmical law of sympathetic association will then be lost to an ungrateful world, and Keely will rise on his vibratory mediums into the far outreach after a life spent in over-reaching, amongst others, Mrs. Moore.—*London Electrical Review.*



BERNARD EDWARD SUNNY.

Mr. Sunny was born in Brooklyn, in 1856, and at the age of sixteen entered the service of the Atlantic & Pacific Telegraph Company in New York. In 1875 he was transferred to Chicago and was successively night manager and manager of the Chicago office. In 1879 he accepted the position of superintendent of the Chicago Telephone Company and served in that capacity for nine years, during which time he witnessed the growth of the business from 400 to upwards of 6,000 subscribers. He was then made president of the Chicago Arc Light & Power Company, which office he held until 1891. For the past five years he has been successively Western manager of the Thomson-Houston Electric Company and General Electric Company and thus has his experience covered practical service in the fields of telegraphy, telephony, and electric lighting. Mr. Sunny also rendered valuable aid in first inaugurating the systems of underground conductors for both the telephone and electric light service now so commonly in use. He was chiefly instrumental too in the building of the "Intramural" railway at the World's Fair and was the president of the company which carried out that project, an undertaking which may be said to have given an impetus to the application of electricity for railway purposes such as perhaps would not have been otherwise accomplished in years. Mr. Sunny was twice elected by the vote of the electrical fraternity in Chicago as a director in the World's Columbian Exposition, but resigned his position to build the "Intramural" road. He has at one time and another contributed many valuable papers to the electrical press and they have always been widely read and regarded as very helpful. Mr. Sunny's present position places him in charge of the General Electric Company from Lake Superior to the Gulf of Mexico and from Michigan to Montana. Mr. Sunny is one of those genial, pleasant fellows who have innumerable friends and few if any enemies, but it is in his own domestic circle that he finds that pleasnre and satisfaction which best serves as an antidote to the cares and responsibilities inseparable from business. Mr. Sunny was married in 1878 to Miss Nellie Clifton Rhue, daughter of one of Brooklyn's foremost architects and grand-daughter of James Tytler the famous Scotch historian. Their family consists of two children, a girl of eight and a boy of four years, naturally claimed by Mr. Sunny to be "the finest in the land."

MORE TRUTH THAN POETRY.

Men who've tried to root for business
Without an ad. to aid,
Have worn their rooters out,
Yet failed to get the trade.—*West Union Gazette.*

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students. Personal and Pertinent.

BROWNELL RESIGNS.

We have the misfortune this week to announce the resignation of Chief Instructor Mr. H. G. Brownell.

Mr. Brownell has been elected principal of the manual training school of Louisville, Ky., and will leave Chicago to take up the work of his new position the latter part of this month.

In leaving the National School of Electricity, Mr. Brownell does so with the sincerest wishes of all his late associates for the realization of his highest aims and ambitions. To his earnest, honest and well directed labors, the success of the school, during its exacting formative period, and its early experiences and struggles, has been in no small measure due.

Beginning when there were half a dozen classes in Chicago, he has watched the school grow until there are now more than one hundred classes, aggregating nearly 4,000 students, and extending the length and breadth of the land, from ocean to ocean, and from Canada to the Gulf. His work has included the actual teaching of some times as many as three classes per day, the drilling of instructors for outside classes, the handling of a large share of the correspondence incident to the course, the execution of the plans of the members of the Honorary Faculty who have had in charge the preparation of the three courses, the upbuilding, supply and care of the apparatus, and the direction of it, so that instructors of the various classes might always be supplied. In addition to these varied and exacting duties, he has been the instructor in physics of the electro-therapeutic classes in Chicago, composed of 150 of the brightest physicians of that city and vicinity, and he has found time to study the needs of the profession so that he could anticipate the matter and the method of its presentation, of which they stood most in need.

Mr. Brownell's able services to the school have fixed the position he held on a high plane, and the selection of his successor will not be an easy task.

Up to the present time no one has been chosen, but by the next issue of the ELECTRICAL JOURNAL, we shall be able to make announcement of a new chief instructor.

THE ELECTRICAL JOURNAL and the National School of Electricity unite in commending Mr. Brownell to those who will be his associates in his new field of usefulness and to give assurances that they cannot set too high an estimate on his solid and substantial learning as a scholar, his sterling worth and unvarying loyalty as a man and friend, and his unswerving honesty and integrity in whatever position he may be placed.

BOUND LESSON LEAVES.

A large number of students of the school have made requests for bound volumes of the lesson leaves of the general course. Some of the classes have resolved to bind the leaves they now have. We have concluded, therefore, to have all the lessons recut, making them the same size, and to have well bound as many volumes as may be required to furnish *one copy to each paid student* of the school. The cost will be *one dollar and a half* per copy. All those who are entitled to the lessons, and who want them in the proposed form, may send in that amount by postal order or express or by check, and they will be supplied. Within ten days from this date the printing and binding will be ordered, and those who have not applied for them by that time will be unable to get them, as only a sufficient number will be printed to meet the demand. The bindings will be stiff card board under silk cloth with gold lettering. It is believed that the lessons in this form will be most serviceable.

W. E. Iler, of the Omaha Class, has invented and applied for a patent on an electric process for separating fine or flour gold from its ores, or from placer sands.

RESOLUTIONS OF CONDOLENCE.

SIOUX CITY, IOWA, Aug. 2nd, 1895.

Editor of ELECTRICAL JOURNAL
1427 Monadnock Block, Chicago, Ill.

DEAR SIR: At the last meeting of the Sioux City Class, No. 78, of the National School of Electricity, in view of the recent death of Mrs. I. B. Walker of this city (the wife of the superintendent of the Sioux City Traction Company), the chair, on motion, appointed a committee composed of Messrs. C. D. Randall, Leonard Wheeler and William H Wilsey to prepare suitable resolutions of condolence.

You will find enclosed a copy of the resolutions adopted.

Respectfully,

CHAS. D. RANDALL,
Assistant City Engineer.

WHEREAS, It has pleased Almighty God in his divine wisdom to call to Him the beloved wife of our associate and vice-president, I. B. Walker, be it

Resolved, by the Sioux City Class, No. 78, of the National School of Electricity, that as an organization and as individuals our heartfelt condolence is extended to the bereaved husband and father in this dark hour of his sore affliction.

Resolved, That this resolution be spread upon the minutes of this class, and that a copy thereof be transmitted to Mr. Walker, and an additional copy to THE ELECTRICAL JOURNAL.

CHAS. D. RANDALL,
LEONARD WHEELER,
WM. H. WILSEY,
Committee on resolutions.

Adopted August 2, 1895.

C. E. WOODROW,
President.

Attest: J. D. SMALL, Secretary.

BOOK REVIEWS.

Through the courtesy of Monsieur A. Grelot, editor of the Electrical Encyclopedia, we have received the work of Messrs Georges Dumont and Gustave Baignères upon "The Transmission of Energy at Great Distances by Electricity, and Electric Transmission by the Continuous Current." The foundation of this book was an article presented before the Society of Civil Engineers of France, by the authors in November, 1894, which was highly praised, and is now published at their instance, with numerous additions and illustrations. The authors have thoroughly appreciated the importance of the subject of transmission of energy, from the industrial standpoint, and have carefully discussed the subject in its various aspects. The presentation of the subject is so clear and intelligible that no engineer or electrician can fail to understand it. The scheme of the work includes, first, the transmission of energy at great distances; second, the transmission of energy in factories and at short distances, and third, examples of electric transmission of energy in the industries. The book is freely illustrated, but many of the half-tones are exceedingly indistinct, as is the rule with our friends across the water. Scientists are much hampered by the mediocrity of the photographic processes in Europe.

Publication Notes.

The issue of June 30 of The Revue Générale des Sciences Pures et Appliqués, of Paris, contains articles by M. H. Le Chatelier on Metallic Alloys; by M R. Lezé, on The Modern Creamery and the Condensed Milk Industry; by M. C. Gariel, An Annual Review of Physics, and by M. A. Gay, on The System of Monocyclic Distribution of Electricity.

The issue of July 15 contains articles by M. A. Gay, on Petroleum Motors of Low Power; by M. G. Charpy, A Comparision of the Chemical Actions of Light and of Heat; by M. L. Roule, on Normal Phagocytosis; an article on French Colonization in Africa, and by M. E. Urbain, on The Extension of Industrial Electro-Chemistry.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

In Sweden telephones cost only $6 per year. The service is under government control.

Albany, N. Y., has granted a franchise to the Home Standard Telephone Company to install a telephone system.

The Old Time Telegraphers' Society will meet in New York, September 11, 12 and 13 next. It will be joined by the United States Military Telegraph Corps, which will hold its annual meeting at the same time. The entire party will enjoy the hospitality of the electrical fraternity of New York, and it is needless to say that the event will be a most enjoyable one.

City Electrician Hoag, of Cleveland, recently took the law into his own hands something after the fashion adopted in New York several years ago. Having requested the telephone and telegraph companies to bury their wires without getting any action, he manned a brigade with broad-axes and turned it loose. There are fewer unsightly poles now than formerly, and the wires are being put under ground.

Rev. Russell H. Conwell, of Philadelphia, is such a popular preacher that there is no church edifice in the city large enough to accommodate the multitudes who wish to hear him. It has been a habit for some time past to hold overflow meetings which are addressed by eloquent speakers also, but they are not the Rev. Russell H. Conwell, and he is the man they throng to hear; hence it has been necessary to devise a way out of the difficulty. The aid of electricity was invoked and it came promptly to the rescue. Now by connecting the three auditoriums by the telephone, it is possible for Pastor Conwell to preach, and for his audience in three different buildings to hear him distinctly, the main requisite under these circumstances being good speaking power and a clear and distinct enunciation.

The annual report of the Imperial Japanese Bureau of Statistics contains some interesting facts regarding the extension of telephony. The telephone was introduced in Japan in 1877, but until 1890 was used only in the police service. At that time two exchanges were established at Tokio and Yokohama, with 170 subscribers. The number of subscribers increased from 396 in 1890-91; 821 in 1891-92; 1504 in 1892-93, to 2672 in 1893 94. During this period the telephone lines were extended from 200 kilometres in 1890 to 709 kilometres in 1894. The longest connection is that between Osaka and Kobe, about 40 kilometres. The expenses per subscriber for the last three years were respectively 138, 112.50 and 102.25 francs, and the receipts 189.50, 169, and 179 francs, a net profit in 1891-92 of 51.5 ; in 1892-93, of 56.50 and in 1893-94 of 76.75 francs per subscriber.

Light and Power.

Boston is said to have 220,000 incandescent lights and 6,600 arc lamps.

Albany, N. Y., has declined the proposition to establish a municipal lighting plant.

The city of Fremont, Neb., has awarded contracts covering a complete municipal system of arc and incandescent lighting, intending to do commercial lighting as well as to illuminate the streets.

Rockford, Ill., will own and operate its own lighting plant. The city at present is paying $17,000 a year for street lighting; they hope to effect a saving of from $5,000 to $7,000 per annum and to have four times the present light.

Commerce in New York Bay after dark has been greatly facilitated by attaching to the spar-buoys, which mark the deep channel, incandescent lamps of 100 candle-power each. A cable six and a half miles long furnishes the current from shore.

Wheeling, W. Va., has a municipal lighting plant, and claims the cheapest lighting of any city in the country. In 1894 the cost was 19.73 cents per lamp per night. So far this year the figures only show 14.90 cents with unsurpassed excellence of service.

The Michigan Central Railway Company has placed an order for two powerful 48-inch search lights of 100,000 candle power each. The lamps will be placed at their Falls View Station overlooking the cataract, and will illuminate and make attractive by colored lights at night the Horseshoe and American Falls.

A Canadian corporation has been formed to utilize the power of Niagara on the Canadian side. It is claimed that conditions are favorable to the development of a great power plant there at much less expense than was attendant upon the earlier venture. An open canal four and a half miles long would render available a fall of 320 feet.

Railways.

A trolley car line is projected from Colorado Springs to the Garden of the Gods.

On the North Side, in Chicago, there are in operation 146 miles of street railway. Of this grand total 121 miles are operated by electricity, 17 miles by cable and only 8 miles by horses.

The receipts of the street railway company of Minneapolis for June, 1895, show by comparison with the same month in 1894, a decrease of $8,000, a condition that is attributed to the increasing use of the bicycle.

Capitalists in the counties of Wayne, Fayette and Union, Indiana, will construct an electric line for passenger and freight service, about sixty-five miles in length, and touching the principal points in the three counties. The cost, completed for service, is estimated at $700,000.

General Manager Yuille, of the West Chicago Street Railway Company, says that the trolley costs to operate a great deal less than horses, and earns a great deal more. Horse power, he says, costs about 65 per cent. of operating expenses, while the trolley costs only from 35 to 40 per cent. He adds, also, that on lines where electricity has displaced horses the earnings are nearly double what they were formerly.

A large number of confiding stockholders of the defunct Chicago and St. Louis Electric Railroad are now appealing to law to see if they cannot recover some of the $112,000 which they paid in on account of their stock. There are said to be some 900 victims in St. Louis alone, but as the money has all been expended in surveying, right of way and negotiating of bonds, the chances for the recovery of it are rather slim.

Under the title of the Union Traction Company, the three street railway systems of Philadelphia have been merged into one. The consolidation was brought about with a view to curtailing expenses. The new combination controls nearly 300 miles of track and operates upwards of 2,000 cars. The three companies last year carried over 200,000,000 passengers, while the aggregate receipts were in excess of $10,000,000.

A Baltimore inventor has devised an insulated conductor of electricity for railways operated by the underground system. The conductor in reality is only insulated in part, that portion coming in contact with the shoe being left bare. The insulating material is an enamel similar to that used on kitchen utensils, and commonly known as graniteware. Being virtually glass it forms a good non-conductor. It is claimed to greatly reduce the waste of electricity.

The introduction to trolley car use of the speed recorder is being agitated in some places. It is the same device that has been used upon the steam roads for some years. It will not only record the distance made within a given time, but will record, from time to time, the different rates of speed, so that if, for example, two miles is made in five minutes it will indicate it, and if the next two miles takes twenty minutes, that also will be on record. Where city ordinances regulate the speed it would show at a glance whether there had been an infraction of the law or not.

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The combination which has been talked of for a long time between the Westinghouse Electric and Manufacturing Company and the Baldwin Locomotive Works has finally been consummated, and the work of applying the electrical current for railway purposes will now go on under conditions that will favor success if such a thing is within the range of possibilities. The Westinghouse people on the one hand say that electricity is capable of furnishing the required speed, say up to 150 miles an hour, and that it is only a question of obtaining cars and car wheels that will stand such a strain. The Baldwin people say that there will be no trouble on that score, and so something practical may be looked for as the result of such a combination. It is said that the interests of the two companies will be entirely separate excepting in so far as relates to electric railway matters.

When Cincinnati granted to its street railway companies the right to construct overhead trolley lines a proviso was attached, which reads: "That all said wires, poles and supports shall be removed by said company, upon the order of this board, as soon as an electric system for operating street railroads without overhead wires is in successful operation in any city of the United States." The Board of Aldermen now claims that the time has arrived for the city to take advantage of this clause. The Lenox avenue subway system in New York is pointed to as an example of successful underground operation, and the president of the board, who is in New York, has been requested to investigate the matter so that he may report intelligently upon his return. If his report shall be favorable, the Board of Aldermen will, it is said, take immediate steps to cause the Cincinnati Street Railway Company to place its wires underground.

Superintendent Stanley, of the Cleveland Electric Railway Company, was charged with discharging experienced motormen who were receiving twenty cents an hour and substituting "green" hands at eighteen cents. Mr. Stanley denies the charge, and says: "To say that we are 'firing' old men because they are paid twenty cents an hour and receiving new men at eighteen cents an hour is not true. That is not a business proposition. The experienced motorman is the cheapest in the long run. The majority of our motormen to-day are twenty-cent men. I do not want my family to go down town on a car run by a green hand in these days of crowded streets and accidents, nor does any other man. The salary question cuts no figure in the case."

At North Attleboro, the Walpole & Wrentham branch of the N. Y., N. H. & H. R. R. crosses a street by an iron bridge, under which a line of electric trolley cars runs. The trolley is hung from the girders by three wires, all of which are supposed to be thoroughly insulated. One morning recently as the train leaving Attleboro for Boston at 8:50 approached the bridge, the engineer noticed a blue flame ahead and stopped the train. He went forward to locate the trouble and found the iron bridge on fire, and the iron melting and dropping to the street below. The insulation had in some way become defective and sent the current through the rails. What might have occurred had the train been driven across the bridge is of course only problematical. An electric current of such force would undoubtedly have done great damage to the locomotive, and probably to the persons in the train. Supt. McAlpine visited the scene of the accident and traced the outline of a section of one rail upon a piece of paper. The rail, which was four inches wide, had melted for a distance of several feet, until it was only 2½ inches wide at one point.

General News.

The Exposition at Atlanta will open September 18 and close December 31.

Electricity has displaced 1,800 horses within the past twelve months on the lines of one railway company in Chicago.

Richard Leach, at Sing Sing, who was electrocuted on Aug. 5th, was subjected to the current for one minute and fifty-seven seconds, at the end of which time there was neither pulsation nor heart beat, and the man was pronounced dead.

Minneapolis is determined to have all wires underground, and has served notice upon the interested companies that any wires not so disposed of by Sept. 1 will be cut by the city wire inspector.

Beginning the first of September, there will be a fast train especially for the benefit of trans-Atlantic passengers, on the Liverpool & London road, to be called the American special express, It is to make the distance of 201 miles in three hours and fifty minutes, or forty-five minutes faster than the regular trains.

Hereafter franchises will be assessed in Minneapolis the same as other forms of property, and to this end the franchise of its street railway company has been valued at $10,000. The International Electric Company at $13,000, Minneapolis General Electric Company at $30,000 and the Minnesota Electrical Subway Company at $1,500.

PROPHETIC UTTERANCES.

In the light of subsequent events, an address delivered by the late Sir William Siemens in 1877 was in the nature of a prophecy, since what he then talked of as being merely within the range of possibilities is to-day an accomplished fact. The address was delivered before the Iron and Steel Institute and it is of record that his audience received the statements made with an incredulous smile. Among other things he said: "The advantage of utilizing water power applies, however, chiefly to continental countries, with large elevated plateaus, such as Sweden and the United States of America, and it is interesting to comtemplate the magnitude of power which is now for the most part lost, but which may be, sooner or later, called into requisition. Take the Falls of Niagara as a familiar example. The amount of water passing over this fall has been estimated at 100,000,000 tons per hour, and it's perpendicular descent may be taken at 150 feet, without counting the rapids, which represent a further fall of 100 feet, making a total of 300 feet between lake and lake. But the force represented by the principal fall alone amounts to 6,800,000 horse-power, an amount which, if it had to be produced by steam, would necessitate an expenditure of not less than millions of tons of coal per day. It would not be very difficult, indeed, to realize a large portion of the power so wasted, by means of turbines and water wheels erected on the shores of the deep river below the falls, supplying them from races out along the edges. But it would be impossible to utilize the power on the spot, the district being devoid of mineral wealth or other natural inducements for the establishment of factories. In order to render available the force of falling water at this and hundreds of other places similarly situated we must devise a practical means of transporting the power. As regards electrical transmission, suppose water power be employed to give motion to a dynamo-electrical machine, a very powerful electrical current will be the result, which may be carried to a great distance through a large metallic conductor, and then be made to impart motion to electro-magnetic engines, to ignite the carbon points of electric lamps, or to effect the separation of metals from their combinations. A copper rod, three inches in diameter, would be capable of transmitting 1,000 horse-power a distance of, say, thirty miles—an amount sufficient to supply 250,000 candle-power, which would suffice to illuminate a moderately-sized town."

A TELEPHONE VOICE.

Here is a little romance that occurred recently in Portland. He was a clerk in a large wholesale house and used the telephone constantly. At certain periods his calls were answered by a sweet voice, which seemed to sooth his tired, wornout nerves and strengthen him wonderfully. He grew to listen for that voice, dreamed of it, and finally it became a part of his life. One evening in the theater he heard it behind him and recognized it at once. For a long time he sat as one dazed and dared not look at the possessor of the voice for fear he would be disappointed. But he wasn't, and now they're engaged.—*Portland Daily Press.*

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GOITRE ELECTRICALLY TREATED.

Cases of Exophthalmic Goitre Treated with Success by Robert Newman, M. D., of New York.

Therapeutical measures in these cases have not met with cures, as a rule, and electricity promises to do better according to different reports.

The writer has treated within the last two years three cases of exophthalmic goitre with success, which can be called cured. The first case was a very aggravated one, who had been ten years under electric treatment by an acknowledged authority in electricity. The patient came under the writer's care in the fall of 1893. After one year's electric treatment the patient declared herself cured. The second case was in some respects similar to the other; has been nine months under treatment, is much improved, and still under observation. The third patient was an opera singer, whose mother had died from the same disease. After two years' suffering she broke down entirely. This patient came under the writer's care in December, 1894. In four months' vigorous treatment the patient was cured, so that she could accept another operatic engagement. The treatment consisted in galvanism, applied in different ways, and assisted by occasional spray of the static machine.

Statistics show some cures under different treatment—even some spontaneous cures. The rule, however, is that these cases are not cured, and many end in death. Electricity, judiciously applied, has met with best success.

Prominent symptoms, to which the treatment should be directed, are: (1) Irregular heart action, with nervous symptoms and insomnia; (2) enlargement of the thyroid gland; (3) protrusion of the eyeballs, to which are found different complications and sequels.

The treatment, therefore, would be:

1. Galvanism to the sympathicus, vagus and pneumogastric in such form as to reduce the pulse and stimulate the heart's action, produce rest and sleep, and allay the nervous symptoms. The strength of the current must be regulated according to the toleration of the patient, to the region to be galvanized, to the size of the electrodes, and to the resistance between the two poles. The static electricity will assist to regulate the vascular circulation.

2. The thyroid gland will be reduced with almost a certainty by the negative pole of the galvanic battery.

3. The protrusion of the eyeballs can only be cured by diminishing the new formation of tissues, grown behind the eyeballs. This can be done by the use of the negative pole to the eyes, which acts like an electrolysis, absorbing the foreign tissues.

Any complications have to be treated according to indications. Surgical means have not been successful.

There should be avoided: too strong currents; too long seances, which tire the patient and over-stimulate; internal electrolysis, and surgical electricity. The faradic current has been used and recommended, but it seems it is contra-indicated as a severe measure which over-stimulates and disturbs the diseased nerves.

With regard to general rules, avoid also excitement, overexertion, emotions, stimulants, strong tea and coffee.

It is evident that the treatment, and especially the application of the electricity, must be intrusted to an expert, and that the family battery for self-use (or abuse) is entirely out of the question.

ELECTRICITY IN MEDICINE.

Among the various agents used in medical practice, none has been the subject of more conflicting testimony or more diverse opinions than electricity, and none has more readily lent itself to charlatanism, quackery and abuse; yet those who have used this force intelligently and with a purpose to observe carefully and without prejudice, are confident of its powers for good. Few physicians, unfortunately, have received the training in exact science that should enable them to understand the limitations and applications of electro-therapeutic measures, or even to use the terms of electric science in a definite manner. Nor will this condition of affairs be remedied until medical colleges shall insist upon a knowledge of the fundamental principles of physics as a preliminary qualification for admission, and shall create chairs for the teaching of medical physics.

In recent text-books of therapeutics, terms are used and distinctions made which have been abandoned by electricians generally, just as the old chemic nomenclature persisted even in our pharmacopeia until the 1890 edition, and is still to be found in the writings of the vast majority of physicians.

Under commercial stimulus on the one hand, and the influence of the general scientific advance upon the other hand, almost incredible progress has been made in the development of the science of electricity and in applications of its powers to various affairs in daily life. There is no good reason why medicine should not share in this progress.

The American Electro-Therapeutic Association is doing good work, yet at every session of this body, a number of papers are read, which judicious conservatism on the part of the Committee of Arrangements would have excluded. Papers making extravagant claims and alleging impossibilities, scientific and pathologic, are not calculated to awaken confidence on the part of those already inclined to be over-skeptical. Nevertheless, many real advances are to be credited to this Association and its members, as well as to physicians working in the subject and not members of the Association. To some of these, we will take occasion to allude hereafter; meanwhile we urge our readers, one and all, to make themselves familiar with the possibilities and powers of electricity in therapeutics, and they will find that using it in definite ways for definite purposes and under scientific limitations, they can accomplish by its means much that is otherwise entirely beyond the reach of medicine.—*Philadelphia Polyclinic.*

ELECTRICITY FOR VOMITING IN PREGNANCY.

Larat and Gautier, (Revue de Therap. Med. Chirurgicale, viii, p. 242, 1895) recommend galvanic electrization as the best remedy in the vomiting of pregnancy. The method is important; the positive pole should be applied under the clavicle between the insertion of the two tendons of the sterno-cleido-mastoid muscle; this positive electrode should be about the size of a silver half dollar, covered with a piece of wet chamois skin. The negative electrode should be placed over the epigastric pit. The current may be feeble; 8 to 10 milliampères are nearly always sufficient, but the precaution should be taken to open and close the circuit slowly. The sittings should last from a quarter to half an hour, and repeated several times a day in case of obstinate vomiting. From twenty-four to forty-eight hours are required to effect marked relief. Ribes has also obtained equally good results by the use of electricity in the vomiting of pregnancy.—*Revue des Sciences Medicales.*

ELECTRICAL REACTION OF THE EYE.

It has been observed by Velhagen, after extensive research, that the electrical reaction of the eye is changed in disease of the optic nerve. The examination was made by placing one sponge upon the nape of the neck, while the other was placed over the eye. A galvanic current was used. Children from ten to fifteen years of age observed the first flash at the interruption of the current, when the amount of current employed was 1-20th to 1-15th of a milliampere. In adults, a current of 1-13th to 1-8th of a milliampere was required. In cases of atrophy of the optic nerve, 3-4ths of a milliampere was required to produce the characteristic reaction.

THE UNDERGROUND TROLLEY.

Down in a conduit, underneath the ground,
Is where the railway trolley in future will be found.
Carrying the current along on copper bars,
Down in a conduit, underneath the cars.

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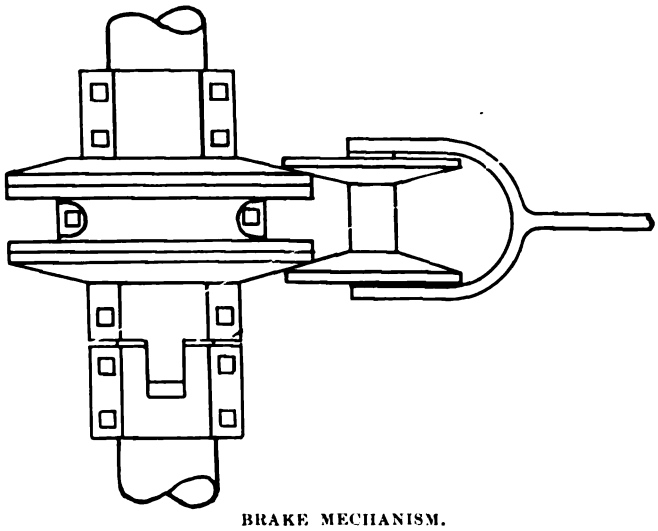
A NEW AUTOMATIC BRAKE.

Under Severe Test It Proves Itself Well Adapted to Bring a Car to a Sudden Stop.

As the speed of electric cars is increased, the question of quick stopping becomes gravely important, yet the necessity to stop so that motors are not injured, and so that people are not thrown forward and jerked about, is of quite equal importance.

A car brake that seems to meet all the requirements, has just been put into service for exhibition on the Cicero and Proviso Road of West Chicago. The inventor is Mr. E. Prouty, who has done good work before in the line of mechanical improvement, and already the Prouty-Noble Company is organized to make and sell the brake.

A test of the brake was made on the afternoon of August 8th, in the presence of several expert railroad men, among them be-



BRAKE MECHANISM.

ing W. K. Bowen, General Superintendent of the Chicago City Railway, General Manager Fuller, of the West Chicago Street Railway, City Electrician J. P. Barrett, and Alderman E. J. Noble, who is interested in the brake. The brake had been mounted on one of the electric cars and the car was running on regular schedule when the trial was made. The party, including a number of newspaper men, made the round trip on the train to Maywood, trying the brake under all the exacting conditions of regular travel. Members of the party took turns at the motor, and in handling the brake.

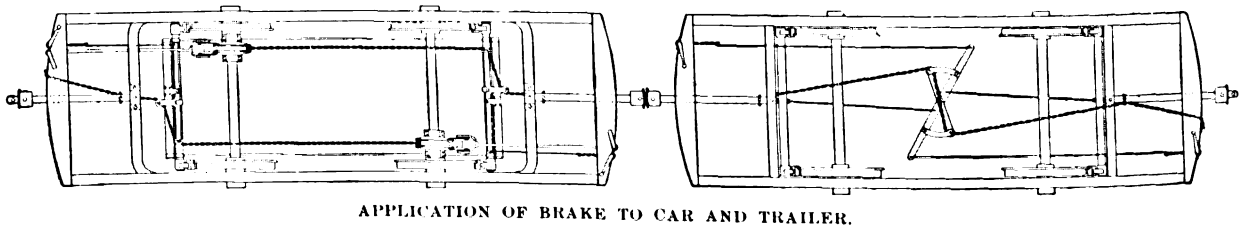
Leaving the 40th street station, there is a long stretch of level road, which gave opportunity for reaching high speed. On this part of the road stops were made from a maximum speed of about 20 miles an hour in 60 feet of space. On the return trip there was one stretch of two per cent. down grade, and from the same or a greater maximum speed the stops were made in less than 90 feet. Being at full stop, and the brake set, it took hold and began to act before the car pulled up 30 inches, and was in full control of the car. Those who were at the motor at different times were surprised at the rapidity with which the brake went to work.

But the point that seemed to meet with the greatest favor was the fact that the wheels were rarely made to slide, and at no time was there that jerky motion that we have with most other brakes, and persons standing up when the brake was applied were not thrown forward, as is usually the case.

It was the verdict of all who were present that the new brake met conditions that were urgent, and that its adoption would tend to decrease many of the accidents, both to cars and people, that have been so common heretofore.

The brake consists essentially of a double flange spool or pulley, running idly on one of the car axles between two discs, one of which is clamped fast to the axle, while the other is loose upon it. This latter is made to turn with the axle by means of a sort of feather, as shown in the accompanying diagram, which thus allows a slight lateral motion. Where there is not space enough on the axle between the motor and the car wheel to accommodate the notched collar it is dispensed with and a pin or other key is set into the axle under one of the flanges. The key way in the hub of this flange fits loosely over the key, thus permitting the flange to slip back and forth freely. The lateral faces of the pulley are faced off, as are also the faces of the discs, so that when the discs are slipped together upon the car axle they will pinch between them the idle pulley, and thus wind up a chain, one end of which is fast to the center part of the pulley. The two discs are brought together by means of a spool hung in a yoke. When this spool is moved toward the car axle its inside tapered faces come into contact with the outside tapered faces of the discs upon the axle, thus crowding them together. The spool is moved backward or forward by means of a simple brake lever, not unlike the one commonly used. A six inch movement of this brake lever in either direction from its normal position will cause the spool to press the discs tightly against the faces of the pulley, and will cause the chain to wind up, thus setting the brake. All of these pieces of apparatus, together with their positions upon the car, are shown in the accompanying diagram. It will be readily seen that it makes no difference whether the car is running backward or forward, or what the speed is, the chain will be wound up tight with a certain number of degrees of revolution of the axle. By actual experiment it has been determined that when the chain is slackest a motion of the car of thirty inches will wind it up and apply the brakes tight. The actual strain upon the chain depends upon the amount of pressure between the discs and the faces of the chain pulley. This can be graduated very nicely, and the car can be stopped either very gradually or very suddenly.

By duplicating this arrangement on the other axle of a car it is possible to operate it from either end. The same mechanism will apply the brake to one or a number of trailers without any greater effort on the part of the motorman than is required to stop a motor car. All of the parts are made of cast iron, and are so arranged that they are easily lubricated. This brake may be attached to any car, propelled either by cable, horse or electricity, without disturbing the brake mechanism which is already there. Even when the brake is applied most vigorously the car does not come to a stop as if it had run into something, but comes to a stop quite gradually. The brake can be released gradually or quickly, as the motorman sees fit. The spool is hung in such a manner that when the operator lets go of the brake handle the spool falls of its own weight away from the flanges on the axle, and the brake is released. When left to itself, therefore, the brake is always off, and is on only while the brake lever is being held in the proper position.



APPLICATION OF BRAKE TO CAR AND TRAILER.

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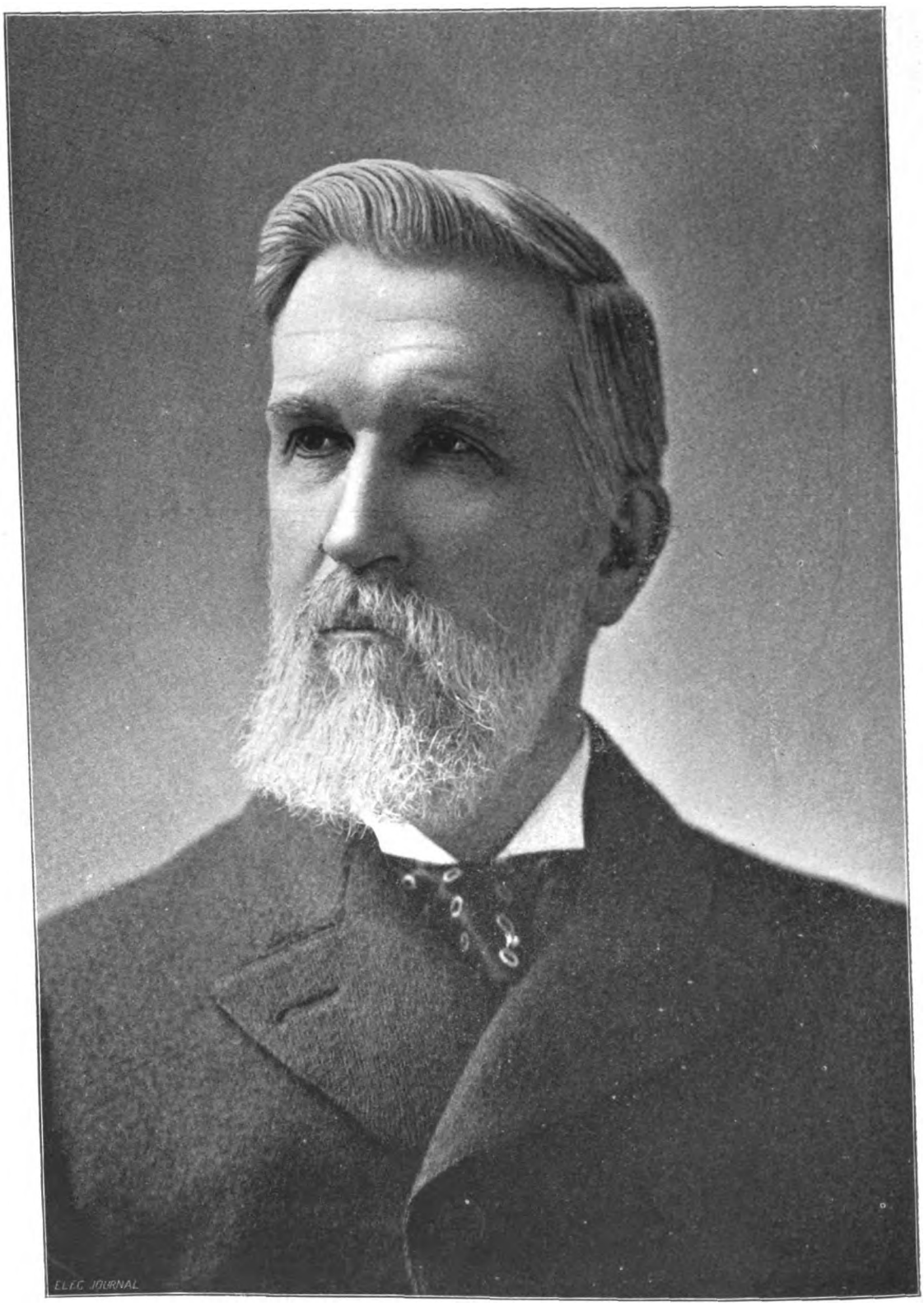

ELISHA GRAY, LL. D.

Inventor of the Harmonic Telegraph, including the method of telegraphing Composite Musical Tones. The first to describe a method of transmitting Oral Conversations Telegraphically; also inventor of the Telautograph.

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The Electrical Journal.

Vol. 1. CHICAGO, SEPTEMBER 1, 1895. No. 7

WHAT ACTUALLY TAKES PLACE.

An Experimental Investigation of the Rotary Field — Photographic Maps Indicating Lines of Magnetic Force.

TWO AND THREE PHASE CURRENTS COMPARED.

The rotary field, produced by polyphase currents with suitable phase differences, has been the subject of much discussion ever since its invention by Tesla and Ferraris. The discussion turned at first on the relative uniformity of the magnetic field in the two-phase and the three-phase systems. Superiority was claimed for the latter, because the relative variation in the total number of ampere-turns throughout a complete period was less than in the two-phased system. This conclusion was reached by finding the maximum and minimum number of ampere-turns in the two systems without reference to the question of phase difference.

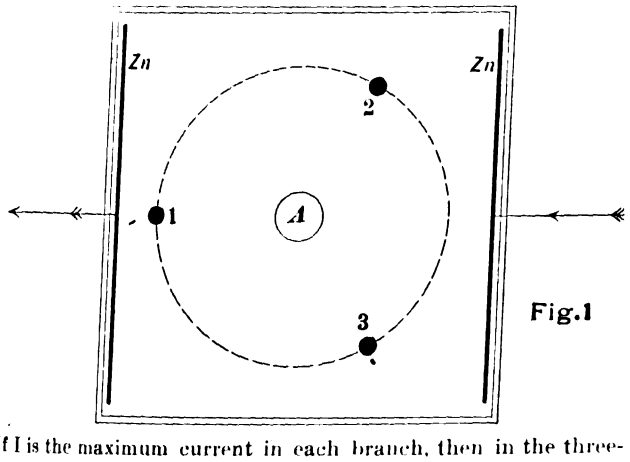

Fig.1

If I is the maximum current in each branch, then in the three-phase system the simultaneous values of the three currents are.

$$i_1 = I \sin \omega t;\ i_2 = I \sin (\omega t - \tfrac{2}{3}\pi);\ i_3 = I \sin (\omega t - \tfrac{4}{3}\pi).$$

The minimum sum of these three currents, irrespective of sign, occurs when either current is zero. It is $I \mid 3$. The maximum is found at points 30° distant from the minimum and is $2I$. The ratio between the maximum and the minimum is therefore $2 \mid 3$, and the minimum is 13.4 per cent lower than the maximum. The ampere-turns pass through the minimum value six times during each complete period.

In the two-phase system the simultaneous values of the two currents are

$$i_1 = I \sin \omega t;\ i_2 = I \sin (\omega t - \tfrac{1}{2}\pi).$$

The minimum arithmetical sum of these is I and the maximum $I \mid 2$. The ratio of the maximum to the minimum is $\mid 2$ and there is a minimum four times in every complete period. The minimum is 29.3 per cent less than the maximum.

Now if the coils in either case were wound over one another on a straight bar composing an open magnetic circuit, then the several magneto motive forces would be in the same line and the flux of induction, or at least the resulting magnetizing force, would undergo the variation indicated above. But when the coils are wound on a ring of iron in the proper relative positions, then the magnetizing forces, considered as vector quantities, are not in the same straight line, but make the proper angles with each other in either case to produce a uniform resultant magnetizing force, rotating with uniform circular motion, when treated according to the principles applying to the composition of simple harmonic quantities.

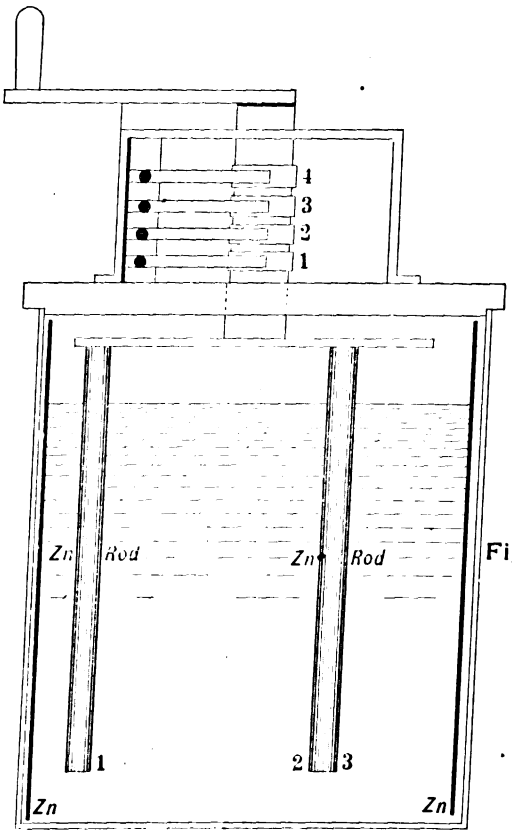

Fig.2

In the more recent treatment of this subject the magnetizing forces, due to the several coils, have been considered as simple harmonic vector quantities, and it has been assumed that they combine to produce a single resultant magnetizing force, constant in value, and rotating with uniform speed around the ring. The object of the present investigation is to determine to what extent this conclusion holds in an iron ring suitably wound with

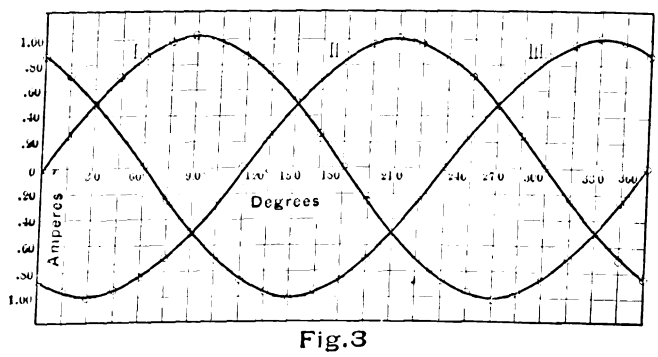

Fig.3

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coils, through which either two-phase or three-phase currents are flowing. The magnetizing force is known only by the magnetization produced, and the flux of induction can be mapped out by means of iron filings in the usual manner, provided means can be found of obtaining polyphase currents and of holding them at fixed values corresponding to any definite phase, until the resulting field has been obtained by the iron filings. When a number of such pictorial representations of the field at equal angular distances have been obtained and fixed, they form a portion of the series of magnetic changes which the magnetic field undergoes during the continuous flow of two-phase or three phase currents.

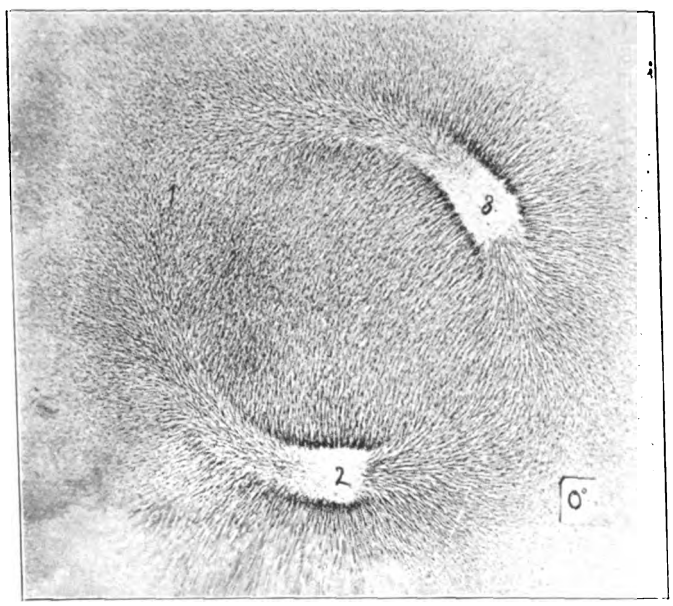

FIG. 4.

A very simple device for this purpose, first suggested by Mr. F. A. Sager, a student at the time in my laboratory, is shown in figures 1 and 2. A large square battery jar is filled three-quarters full with a solution of zinc sulphate containing 200 to 300 grammes of the salt to the litre. Into this solution dip two sheet zinc plates on opposite sides of the jar. A terminal is attached to each, and a current of about three amperes is passed through from a storage battery. To an insulating disc are attached three zinc rods, 1, 2, 3, for three-phase currents, and the disc is made to revolve by means of a vertical axle A and a handle shown in Fig. 2. The zinc rods are arranged around a circle 120° apart. Metallic connection is made between the rods and the insulated brass rings, 1, 2, 3, on the axle (Fig. 2). There are four of these rings, and four brushes insulated from one another, press against them. From the binding posts at the further ends of the brushes conductors are led to the ring serving for the rotary field.

The three rods and the connected circuits form shunts to the direct current flowing through the solution in the jar. A little consideration will serve to show that if the disc be uniformly rotated, three-phase currents must flow through the three conductors, which are assumed to be connected with the coils on the ring, either in a mesh or a star combination. If so, it is only necessary to fix a graduated circle to the cover of the jar, and concentric with the axle of the disc, in order to be able to arrest these three-phase currents at any simultaneous values desired, and to develop the curves displaying the lines of force in the ring. Fig. 3 shows three-phase currents plotted from measurements made on the three circuits by means of a Weston milliammeter. They are very nearly sine curves and have equal maximum values.

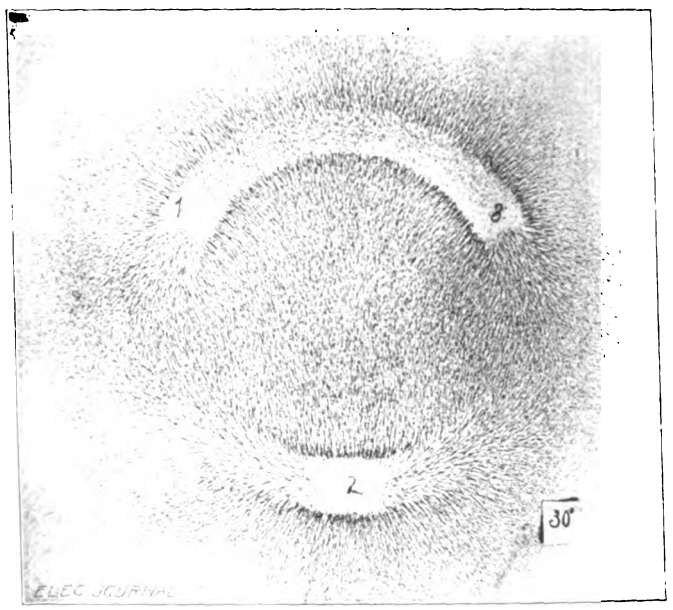

FIG. 6.

For two-phase currents it is only necessary to use four zinc rods 90° distant from one another, and the four rings and brushes. The glass jar used was 17 cms. square and 24 cms. deep inside.

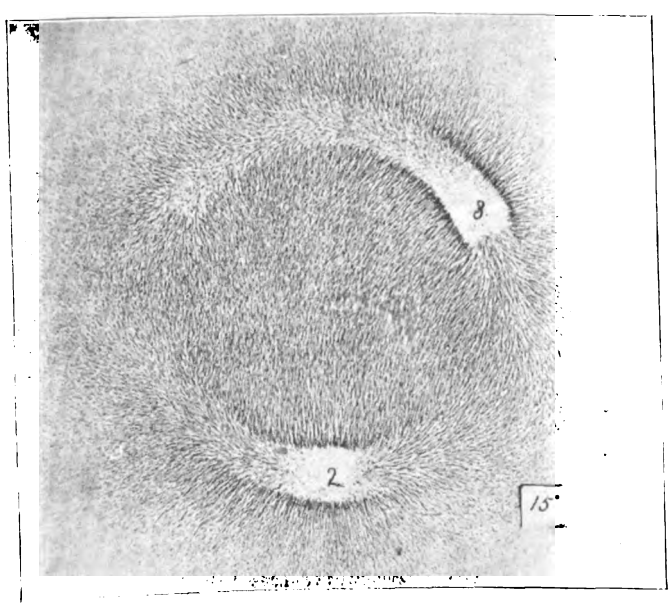

FIG. 5.

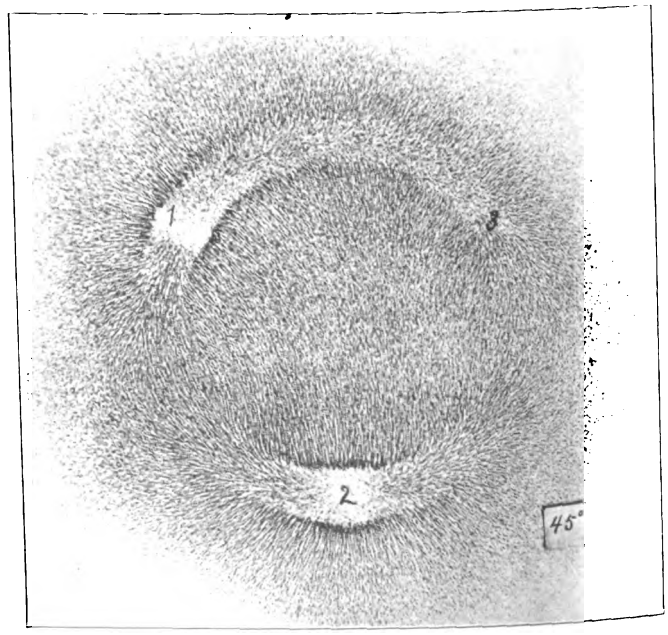

FIG. 7.

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The zinc rods were 6 mms. in diameter and 20 cms. long, and were set in a circle 14 cms. in diameter.

It is evident that an armature, the number of whose commutator bars is some multiple of both three and four, might be used instead of the device described. But its resistance would need to be considerable, so that the shunt currents should be

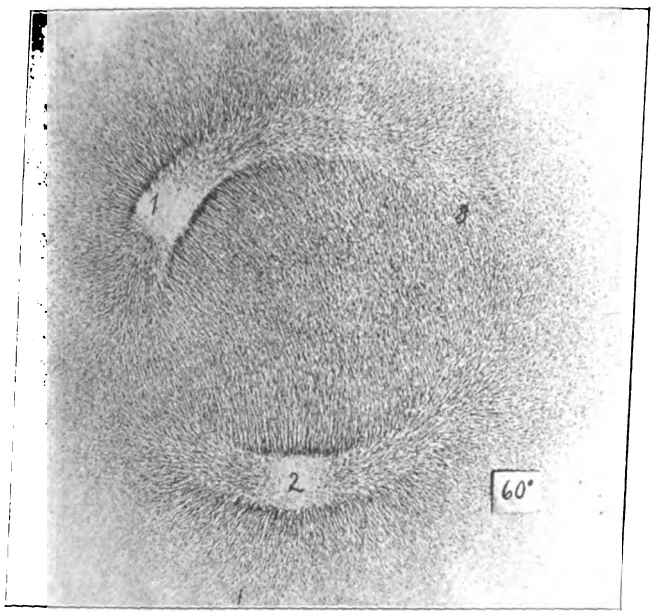

FIG. 8.

large enough to magnetize the iron ring. Of course it would need to be provided with rings, connected to the proper commutator bars, for the alternating circuits as in a rotary converter. The number of successive steps in the series of changing values of the alternating currents would in this case be limited to the number of commutator bars; while in the device which I have used the currents pass by insensible changes from one value to another, and the number of steps in the series can be varied at pleasure. Passing from the consideration of such an armature, with its commutator and rings, to a similar one mounted so as to rotate in a magnetic field, and forming with it a rotary converter, it is a fitting time to inquire what offices the field magnet serves

FIG. 9.

in this most interesting modern device. It is easy to point out three at least:

First, it applies a torque to the armature and so gives to it the requisite speed of rotation.

Second, by a proper proportioning of the field and the armature, it suppresses the sparking which must take place at the commutator if the armature were rotated mechanically. This it does in the same manner as in a motor.

Third, it sets up a counter electromotive force in the armature, which serves the same purpose in shunting the currents

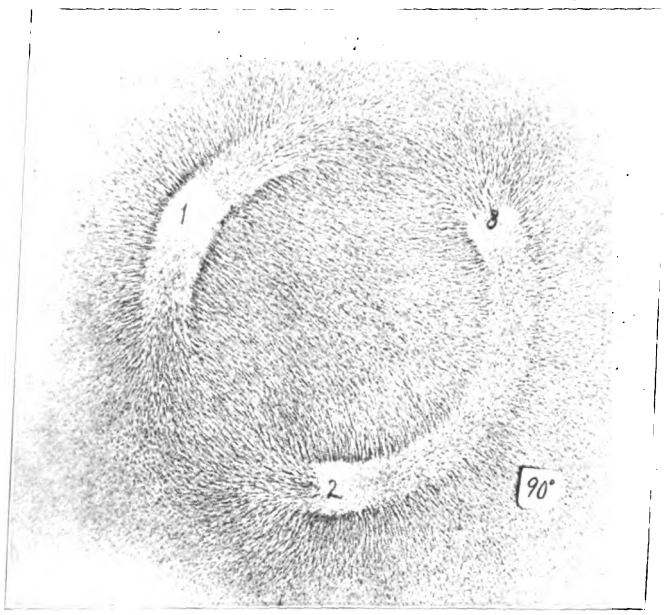

FIG. 10.

through the alternating side of the machine as the considerable resistance which would otherwise be required in the armature, and which in my apparatus is supplied by the electrolyte.

The iron on which the first two series of experiments were made was composed of sheet iron rings, 17.85 cms. outer diameter, and 13.3 inner; these were piled up to a thickness of about half a cm., and after a service of insulating tape, the ring was wound with 384 turns of insulated wire. This wire formed a closed winding as in a Gramme ring, and to it were soldered six wires at the points required, either for two-phase or three-phase currents, one connection being common to the two sets. The ring was laid horizontally on a table and close over it was a piece of drawing

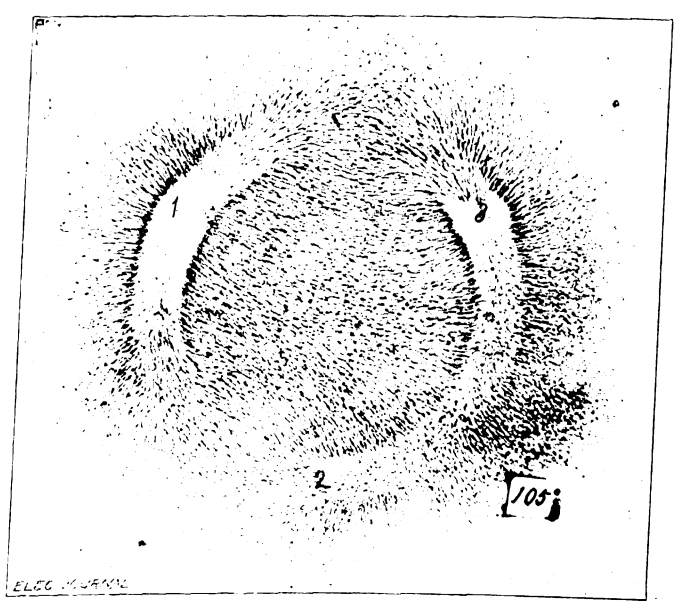

FIG. 11.

paper tightly stretched on a wood frame. On this paper the magnetic curves were developed with iron filings in the usual way, and these curves were photographed by means of a vertical camera without moving the frame and paper.

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The first series of curves for this three-phase mesh combination consists of nine photographs taken 15° apart around the circle, marking the rotation of the zinc rods (Fig. 1). In Fig. 4, current I was zero, and current II and III were of equal value and of opposite sign—that is, the current of 0.96 ampere entered at one point 3, and came out by the other point 2. Two well defined poles were

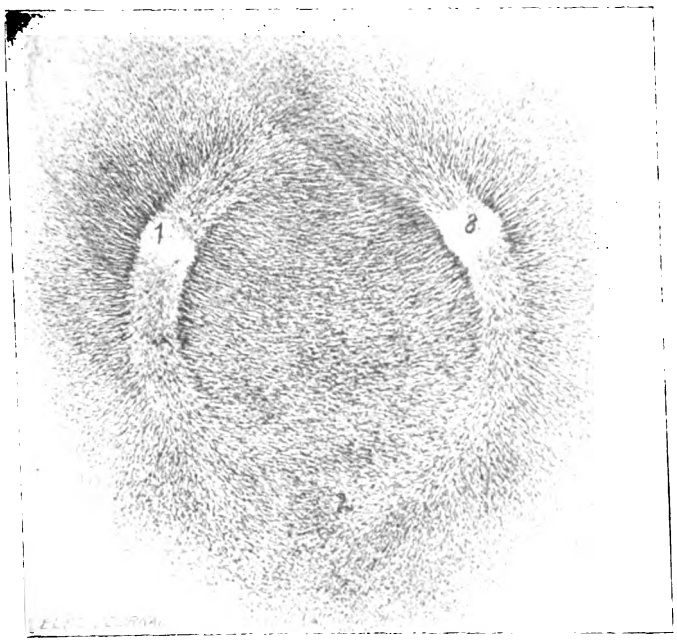

Fig. 12.

developed at these points 2 and 3, 120° apart. In Fig. 5 a current is flowing in at point 1, as well as at 3, and the pole at 3 has spread out to 1. In Fig. 6 current I and III are equal and of the same sign, the corresponding pole is uniformly spread out all the way from 3 to 1, while pole 2 has not moved in the least. The former is now a distributed pole extending over 120° of the ring. Passing through Fig. 7 to 8, the broad pole has gathered itself up and there are now two concentrated poles at 1 and 2. Current III has been reduced to zero (Fig. 3) and pole 3 has disappeared. Through all these changes the pole at 2 has not moved, though it has doubtless changed strength. It has been a sort of centre of rotation while the other pole has swung round from 3 to 1. In the next four figures, 1 is the centre and 2 swings round to 3. The zinc rods have been rotated through 12 ° and the two poles have been carried a third of the way around the iron ring. In the next swing 3 becomes the centre and 1 is carried round to 2. We should then have the same diagram as Fig. 4, but the poles would be exchanged or of opposite sign. It will be observed that in these figures only one of the poles moves at a time. I cannot describe this motion better than to liken it to that of a measuring worm. It stretches out in advance 120° and then gathers itself up from the rear into a compact pole. And this operation goes on at opposite sides of the ring alternately. If we consider the neutral or equatorial plane of the ring, that appears to pass through the centre of the ring and perhaps revolves with a uniform motion.

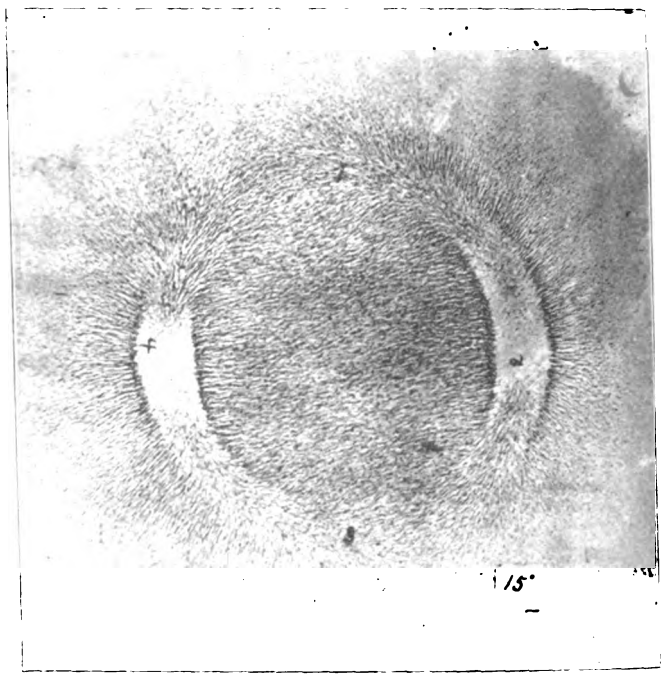

Fig. 14.

If this ring were used as the field or primary of an induction motor, with another ring wound with a closed coil or coils mounted as an armature within it, then the slip, or the difference between the angular velocity of the rotary field and that of the ring, would not be the same on the opposite sides of

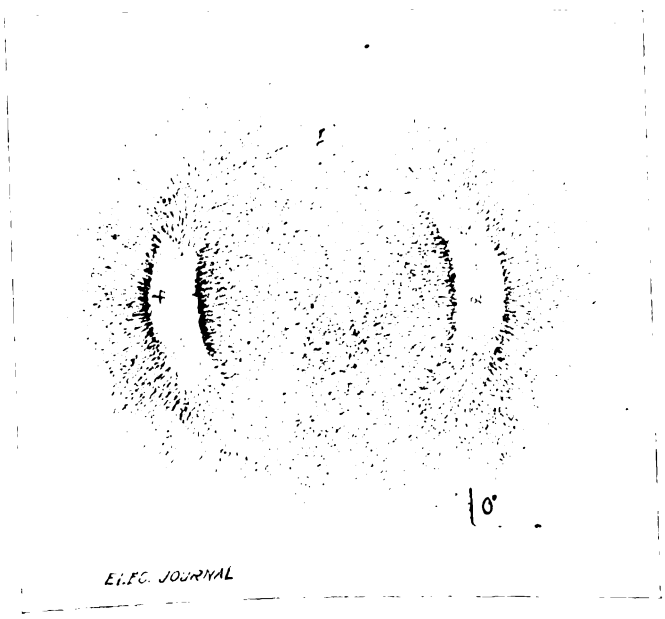

Fig. 13.

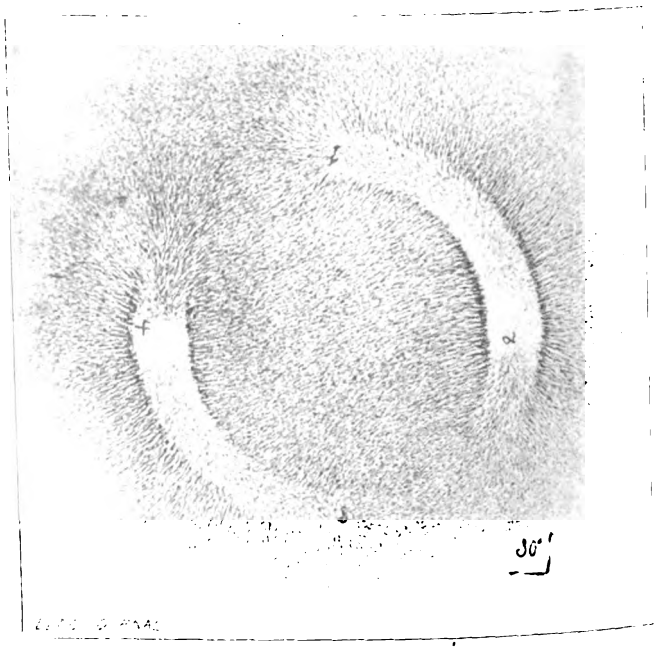

Fig. 15

ring; for while either pole is the centre of the motion exhibited in these photographs, it remains stationary for a sixth of a period

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while the armature moves past it, thus producing a negative induction or torque.

The next series, Figs. 13 to 19, were made from the same ring by means of two-phase currents. The angular positions are again 15° apart. In Fig. 13 current I is zero and II has its maximum value, while in Fig. 16 the two currents are equal. Both

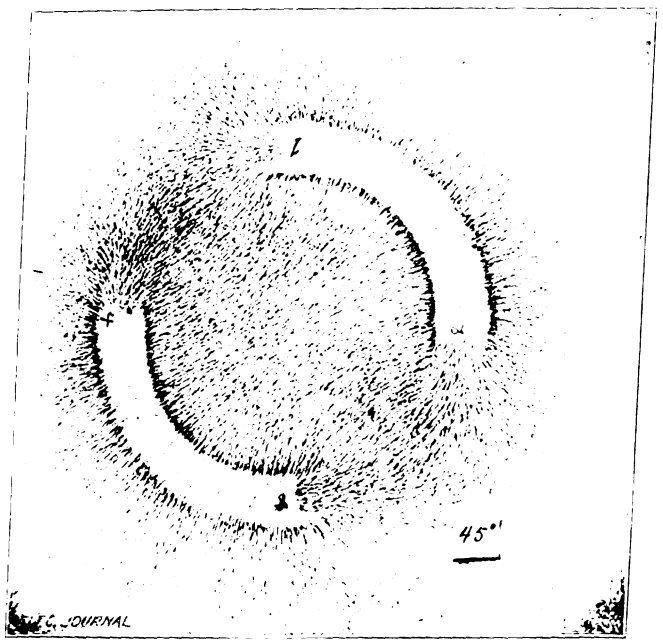

FIG. 16.

poles 2 and 4 have spread out in the direction of the rotation through an arc of 90° with an apparently uniform distribution of magnetization. In the next four figures these broad poles contract from the hinder ends, 2 and 4, and when current II is zero, there are concentrated poles at 1 and 3. These changes have taken place during a quarter of a period, and the poles have rotated through a quarter of the circle. There is no stationary pole in this case, but the motion goes forward by the same measuring worm process as before.

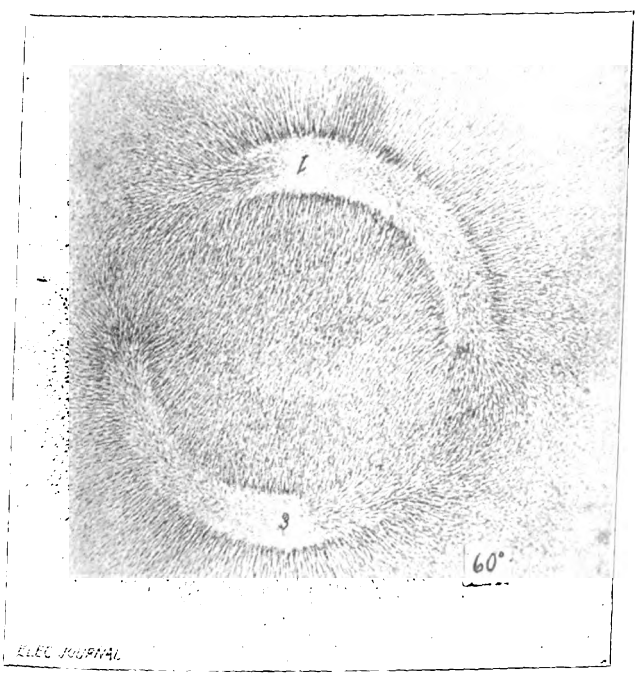

FIG. 17.

When the ring is wound with four coils, connected in pairs to the two circuits in the usual manner, the same figures are produced, the only difference being that they are shifted through a quarter of a period, Fig. 16 being obtained, for example, when one of the two currents is zero.

The third series, Figs. 20 to 28, were made from a larger ring 25.5 cms. in outer diameter, 6.3 cms. radial depth. It was wound with 564 turns divided into 12 sections or coils, which were con-

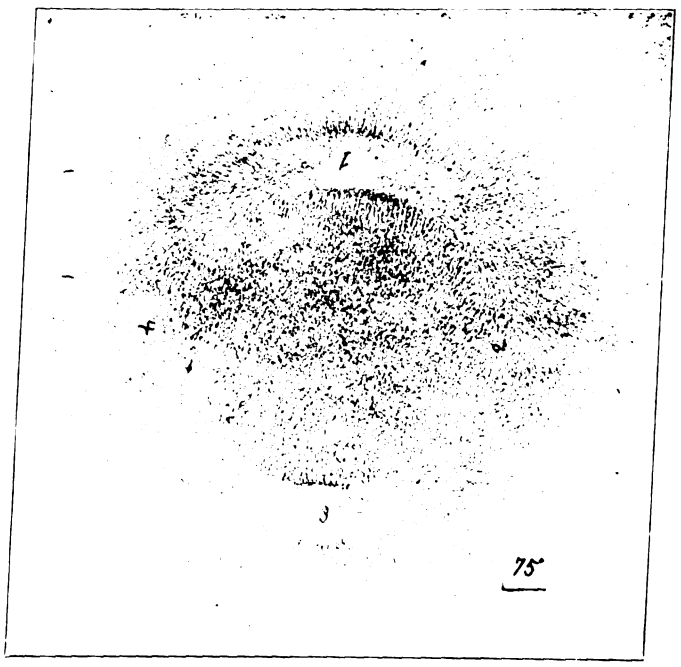

FIG. 18.

nected star fashion (see Thompson's Dynamo-Electric Machinery, p. 711). In Fig. 20 there are four distinct poles, corresponding to a four-pole machine. These spread out left-handedly in the direction of the rotation, till at 60°, Fig. 24, the four poles extend over arcs of about 45° each. All four poles then begin to contract from behind and finally at 120° they again cover the smallest area. During one-third of a full period of the currents, the poles have rotated forward 30°. The same process repeats itself indefinitely.

It is evident that there is no difference in the character of the changes going on in the rotary magnetic field when produced by two-phase and three-phase currents. The same measuring-worm

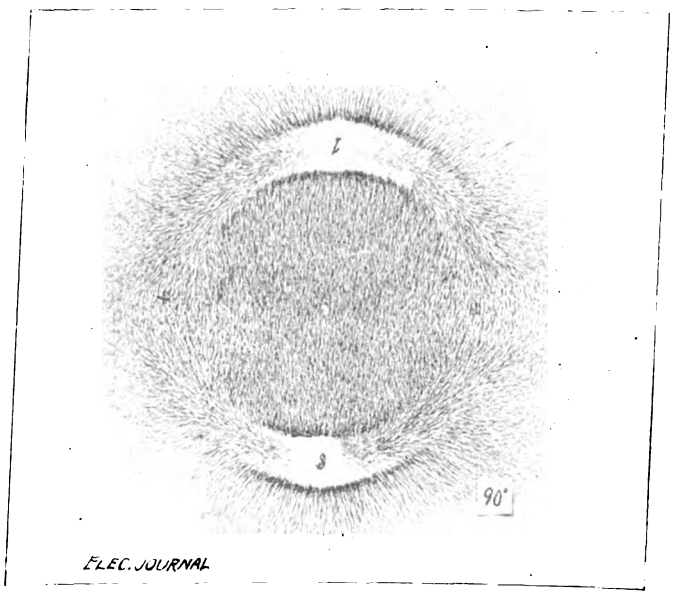

FIG. 19.

progression of the poles is characteristic of the rotary field in both systems. The superiority of either the one system or the other must be decided upon other grounds.

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Much credit is due to two of my students, Mr. W. M. Austin and Mr. H. V. Knight, for the care with which they have taken the three series of photographs from which the illustrations have been made.

Henry S. Carhart

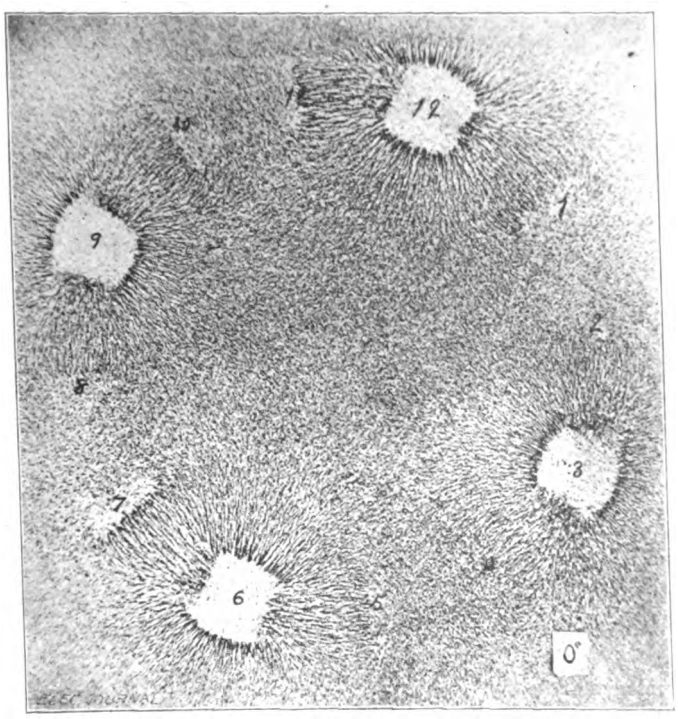

FIG. 20.

A STORY FROM PIKE'S PEAK.

Charles Peters, an English tourist, had a novel experience on the summit of Pike's peak. He made the ascent with a number of ladies, one of whom carried a steel stick umbrella.

When the summit was reached an electrical storm was in progress, heavy clouds hung below the peak, and seemed to flood the valleys. The steel stick of the umbrella soon began to snap and buzz, and Mr. Peters exchanged umbrellas with her. The snapping continued, and the steel frame of the umbrella soon became charged with the electrical fluid, and the muscles of his hand contracted so that he was compelled to wrap a piece of paper around the steel handle. In a few moments more the steel was so heavily charged that his hand was again cramped, and another thickness of newspaper was added.

Everybody who passed him by asked: "What is that buzzing sound?" and when it became known his umbrella had developed into a storage battery he was given a wide berth.

Finally he was compelled to lay the umbrella on a stone until the electricity in the frame became dissipated. Those in the party who carried umbrellas with wooden sticks, or partly

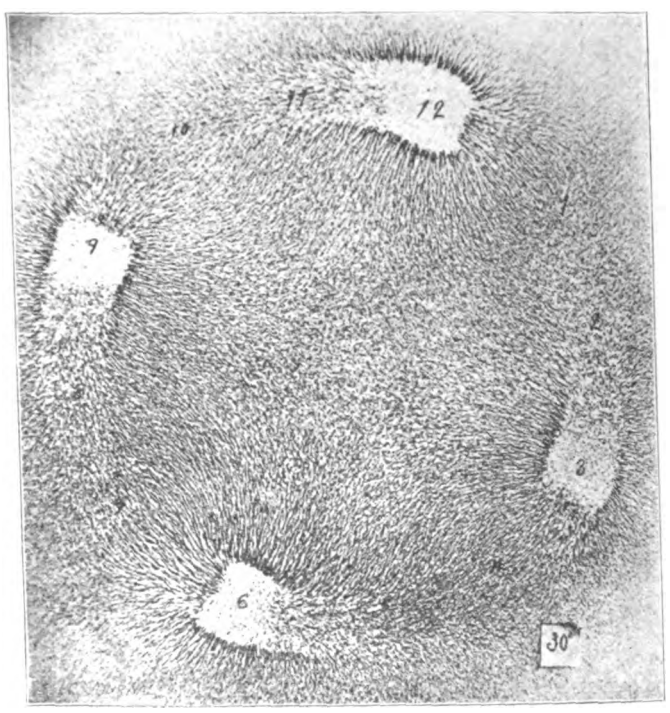

FIG. 22.

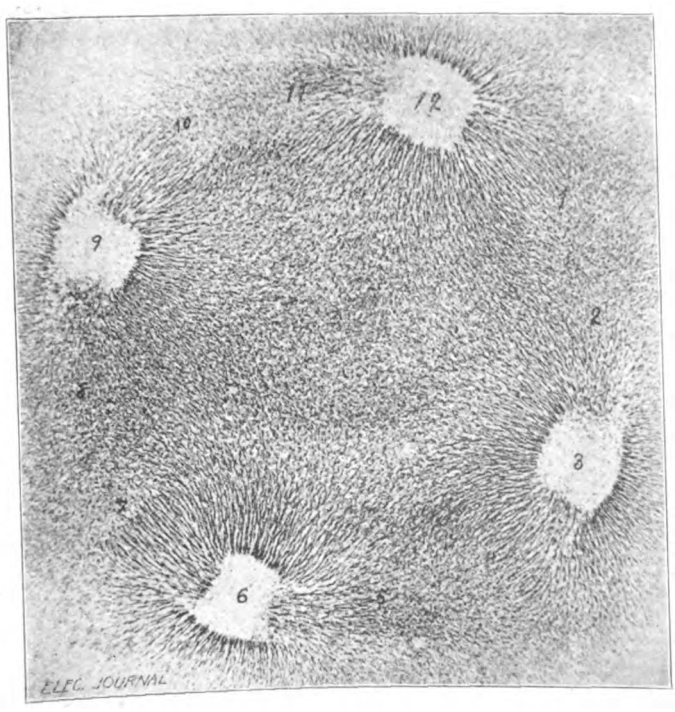

FIG. 21.

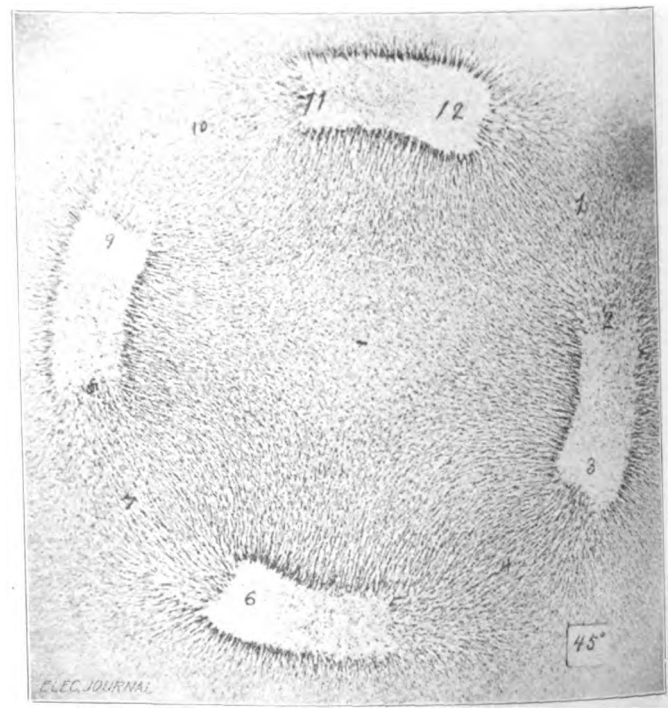

FIG. 23.

wooden sticks, experienced no difficulty whatever. The sensation, however, it is said, only lasted a few minutes, during the height of the storm.

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NAILED THEM EVERY TIME.

Three or four innocent-looking nails, that project about an inch above the sidewalk in front of 131 Canal street, Chicago, furnished amusement recently for hotel runners, cabmen, bartenders, and a lot of other people. Under the sidewalk is an electric light wire which charged the nails. When any pedestrian struck his foot against the nails he would receive a shock and go down in a heap.

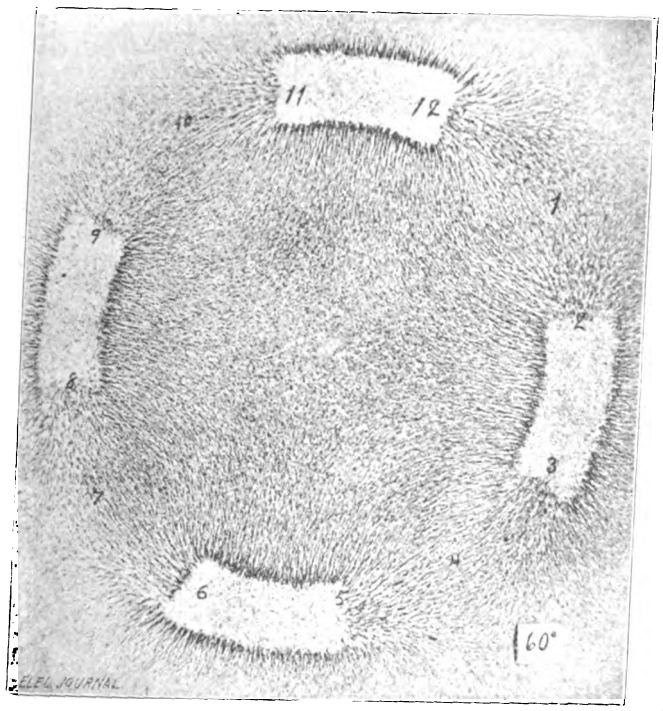

FIG. 24.

Cabmen and hotel runners around the Union depot saw a man hurrying to catch a train yesterday morning. When he got in front of where the nails projected he shrieked and was sent sprawling into the gutter. His satchel went one way and his hat another. As he gathered himself up he said he had been struck by lightning, but as there had been no flash he was soon convinced that he was mistaken. While this man was brushing the mud off his clothes another man came along and stubbed his toe against one of the nails. He, too, was sent sprawling. The source of the trouble was then found out, and for hours the spot was watched by an amusement-loving crowd, Late in the afternoon officer Derrig heard of the nails, and he reported the case to the fire department. The fun was soon stopped.

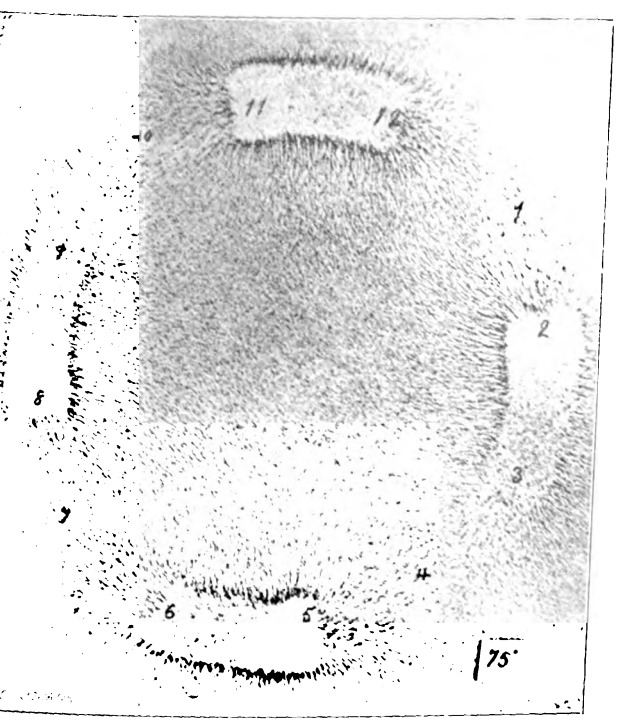

FIG. 25.

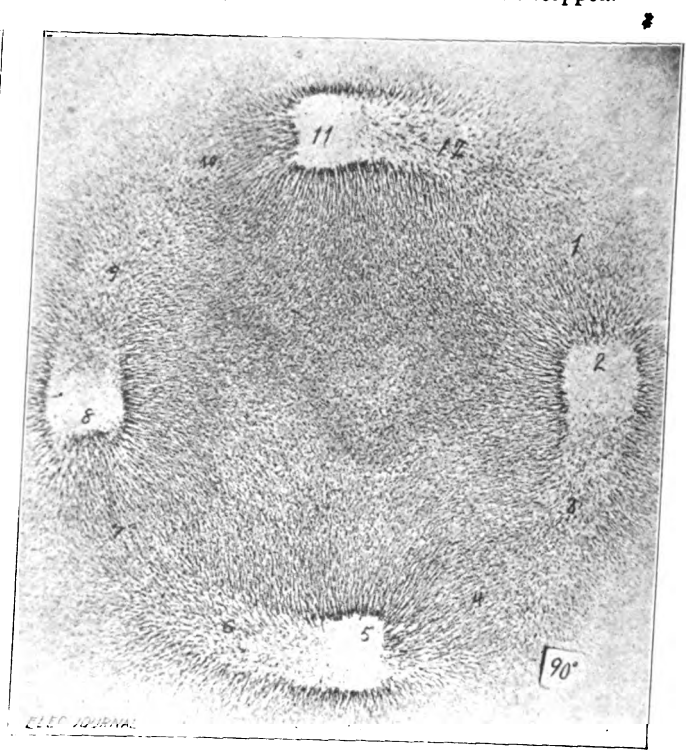

FIG. 26.

AGAIN THE HAWAIIAN CABLE.

Colonel Z. S. Spalding, who recently received a franchise from the Hawaiian government to lay a cable from Honolulu to San Francisco, is preparing to secure the co-operation of the United States government in his undertaking. The matter will be laid before congress in December. In order to float successfully the enterprise, he calculates that nearly $4,000,000 will be

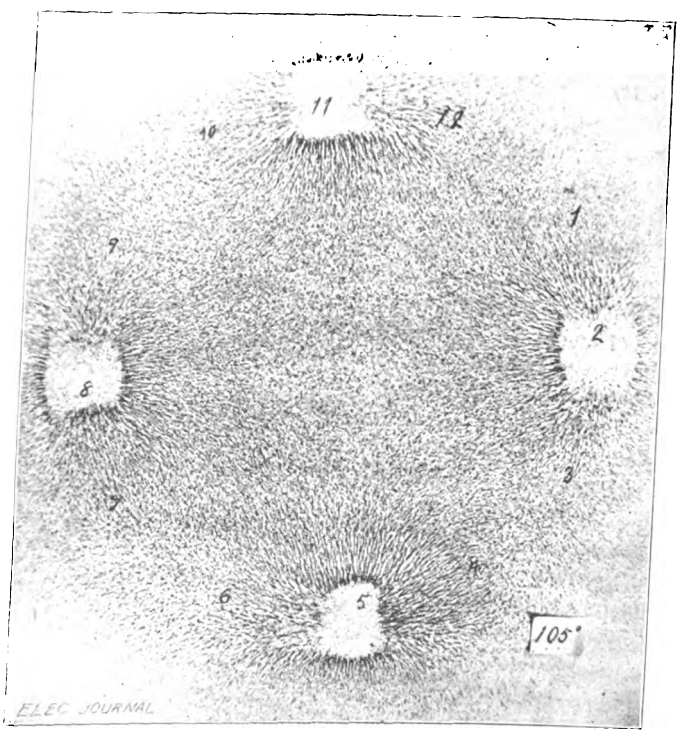

FIG. 27.

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required, and that a yearly income of $400,000 will be necessary to keep it going. The $4,000,000 is to provide all the stations, equipment, cables, right of way, cable ship and working capital. Toward the income the Hawaiian government has pledged $40,000 a year for twenty years, and the "substantial aid" referred to in Colonel Spalding's contract with that government

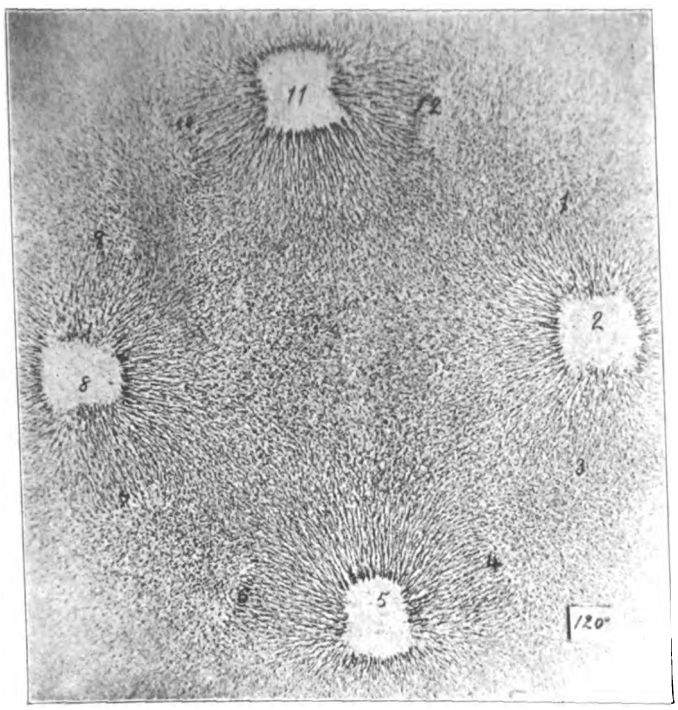

FIG. 28.

to be furnished by the United States government means $260,000 for twenty years. This, in all, would be $300,000 annually, and as the expectation is that the receipts after the first year or so would be $100,000 more, a total of $400,000 would thus be secured. When the second subsidy has been pledged a stock company will be organized. This company will have a capital stock of $1,000,000. One-quarter of the stock will be raised by residents of the Hawaiian Islands, one-quarter by the Chamber of Commerce of San Francisco, which has already been pledged, and the remainder in the east and Europe. Colonel Spalding expects to be able to manufacture and lay the cable within eighteen months from the time of placing the order for it.

SOUTHERN HOSPITALITY.

The following circular letter sent out by Dr. George Brown, of Atlanta, Georgia, is ample evidence that southern hospitality still exists: "From the present outlook the 'Cotton States and International Exposition' will be one of the 'events' in the history of our country, and especially of the south. Realizing the immense number of physicians who will be present from all parts of the United States and other countries, I have decided to offer my mite of southern hospitality to my visiting brethren. Therefore, I extend a cordial invitation to any physician who may visit our city to make my office his headquarters. Send mail, telegrams, etc., in my care, and I will cheerfully engage rooms, etc., in advance, for any one, if advised to do so. The only request I make is to enclose postage for letters of inquiry, which will be cheerfully answered. For any services I may render no fee, commission, or any perquisites whatever, will be received or expected. Fraternally yours,

23½ Whitehall st. "GEORGE BROWN, M. D."

A NEW BOOK.

A book on Electrical Measurements, a Laboratory Manual for students and electricians, by Professors Carhart and Patterson, of the University of Michigan, will be out in a few days.

GOLD MINING IN MONTANA.

In the river bottoms of the far western country, and especially in the bedrock, there are many valuable gold deposits. Any method for working these on a large scale must therefore attract attention among those who are interested in that branch of business. The Gold Dredging Company of Chicago have installed a Bucyrus dredge on a small stream at Bannock City, Montana, and are successfully operating the same by electricity. The power-house is situated on the banks of the stream about 500 feet distance and communicates with the dredge by two No. 000 cables, carried on moveable supports, and connected with the dredge through a two-compartment reel supplied with brush contacts. This admits of keeping the cables always above water while the dredge is working around the stream. On the dredge is a centifugal pump operated by a 30 P railway motor. This flushes the sluice boxes and prevents the gravel from packing as soon as the buckets start to dig. A 60 P motor drives the front and bucket elevator. The first elevator does the digging down to bedrock, 28 feet deep, and empties the material into a rotating grizzly from which the tree stumps and boulders are discharged through a shoot to the dump-pile. The second elevator takes the remaining fine gravel and mud from the grizzly to the sluice boxes from which it is washed, leaving the gold behind in the riffles. A 20 P R R motor drives the hoisting and capstan gear. Arc and incandesent lights are also installed for night work in cleaning up the bedrock after a pit has been cleaned by the dredge. The 160 P necessary to operate the dredge, is supplied by a 26-inch single nozzle Pelton wheel, taking water from a ditch sixty-five miles in length, from which a fall of 330 feet is obtained, through 760 feet of 18-inch pipe, almost without a bend. The wheel is direct coupled to and thoroughly insulated from a 100 K. W. Edison standard generator developing current at 500 volts. It will be seen, at a glance, how difficult becomes the problem of governing with so light running a prime mover;

GOLD DREDGING ELECTRIC PLANT.

the wheel and shaft weigh less than 400 pounds, but the Pelton differential governor takes care of the widest variations (160 P to 0, and 0 to 160 P frequently occurring), while a change of load of one-third or one-half is scarcely noticeable on the lamp circuit.

GEORGE J. HENRY.

STORAGE BATTERY PROPULSION.

An experiment will shortly be made with a storage battery street car on the Fourth and Madison avenue line. Six years ago this experiment was tried, but the results were not satisfactory enough to induce the New York and Harlem railway to adopt the cars. One car will now be put on the road, and if the success of it is great enough the company may adopt the system. The car will be of the standard type, the battery, however, will not be carried in the car body, but suspended between the trucks under the car.—*New York Sun.*

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DYNAMO CURRENTS FOR PHYSICIANS.

Lighting and Power Station Service as a Substitute for Primary and Storage Batteries.

A large majority of physicians, who are employing electricity for therapeutic purposes, are still relying upon primary batteries as a source of supply of electric energy. Some may not have access to a dynamo circuit and if they have, and the question of drawing upon it to serve them has been considered, they may have found the use of it for one or another reason impracticable. But the convenience of this source of supply as compared with the primary or even the secondary battery is so superior, so greatly are the annoyances and obstacles which often attend the generation of current by these primitive methods done away with, that no physician or dentist who wishes to avail himself of the many advantages that electricity can furnish him in his practice should be ignorant of the many efficient appliances that can now be furnished for adapting dynamo currents to the peculiar requirements of his work.

Such dynamos as are used for furnishing currents for incandescent lamps are perhaps those that would serve the physician's purposes best since he is likely to have his office wired for lighting purposes, and if the same current that does this is suitable for therapeutic work it can be made to do double duty.

For lighting incandescent lamps both direct and alternating currents are employed, and the kind of work which the direct current will do in therapeutics differs very greatly from that done by the alternating current. But both are very useful. The current from the direct current dynamo will electrolyze; will bring about electric endosmose or cataphoresis; will stimulate nutrition and excite the physiological activity of the tissues. It will, also, by suitable devices to modify it, light small exploring lamps for examining the cavities and passages of the body and will heat the electro-cautery.

It will, in other words, but much more simply and reliably, do all the work which physicians are familiar with as done by "galvanic" or "cautery" batteries. The Edison dynamo current, so largely used for incandescent lighting, is readily adapted to these requirements of the physician. It is delivered on the mains at a pressure of 110 volts or thereabout, and this, by a shunt device, such as the McIntosh Current Controller or Vetter Current Adapter or a rheostat such as the Kennelly or Gish instrument, can be so varied and modified in the physician's office that he is able to adapt it to the requirements of the most delicate or most formidable operation or treatment.

A modifier of the current which acts on the shunt principle is preferable for therapeutic work, since the current and electromotive force are increased or decreased together, and action on the tissues can by this means be more accurately graduated. A modifier that acts by throwing a greater or less amount of direct resistance into the circuit changes only the current and not the electro-motive force.

Other dynamo circuits, aside from the Edison dynamo for incandescent lighting, can be used by physicians for direct current or galvanic work. Any direct dynamo circuit that is reasonably constant and, with a pressure not exceeding 500 volts, may be utilized. Dynamo currents, used to supply power for running street cars and such like purposes, are commonly delivered on the mains at 500 volts pressure, and by introducing a shunt controller, such as the McIntosh, into a circuit of this nature, in series with four 100 volt lamps, the pressure will be so reduced on the controller that it will work admirably.

There is no danger whatever to the patient or operator from the use, in this way, of a current of such high voltage, since a tested fuse is introduced into the main circuit of the shunt which will not allow more than a half ampere of current to pass.

Alternating currents for incandescent lighting are now very commonly employed. Although on the mains, these currents are of high voltage, the transformers used to modify the current for house and office distribution ordinarily reduce this voltage to 100 or 50. This current thus reduced can be employed by the physician for a variety of useful purposes. By putting a transformer into the circuit, such as the "Jewell," the "Watton" or the "Woakes," the current may be so modified at will as to light exploring lamps for examining the cavities and passages of the body, and a cautery of any size may be conveniently heated for any length of time.

This being an alternating, and not a direct or galvanic current, it will not serve for electrolysis or cataphoresis, yet it has very much the stimulating properties upon the animal organism of a true sinusoidal current which, in its physical nature, it closely resembles, and it can be utilized for a large range of therapeutic effects where the main action needed is the arousal of normal physiological function. In using this current a controller or modifier of its strength is required to adapt it to the case in hand, and here again several of the forms of controller mentioned above will be found suitable for this purpose.

There are two forms of alternating dynamo at present, manufactured for incandescent lighting. One gives a high frequency of alternations, about 125 per second, at the customary speed of running, while the other is of lower frequency, only 60 alternations per second. There is undoubtedly some difference in physiological effect, dependent upon the frequency of alternations, since the variation in potential is one of the essential factors in excitation, but just the degree of importance that is to be attached to the number of alternations in a given period of time has not yet been determined by the physiologist, and the therapeutist must await his decision before a scientific interpretation can be given to the empirical effects obtained.

It is possible, by means of a simple device of the nature of a commutator, to make unidirectional current of this alternating current, and if the physician who has an alternating current at his command will supply himself with such a commutator he can then, in addition to the service which he can derive from the alternating current, cover the entire range of therapeutic work which the direct or galvanic current is capable of doing.

Great activity is being shown by manufacturers of electro-therapeutic instruments, and they can be depended upon to keep pace with the growing demand for simplicity, convenience and efficiency in this line of apparatus.

W. J. Hammer

ELECTRO-THERAPEUTIC NOTES.

Von Bergmann, who attributes much of the progress in cerebral surgery to improvements in technique and instruments, employs a circular saw operated by electricity for dividing the outer table of the skull.

Through the energy and activity of Dr. Georges Apostoli, president of the French Society of Electrotherapy, the society has now an official organ, Le Bulletin Officiel de la Société Francaise d' Electrothérapie.

The latest electrical instrument is the autoscope, devised by Dr. Kerstein, of Berlin, for examination of the larynx and trachea. It consists of a thick tube, 20 centimeters long, ending in a gutter-like point; the tube is tightly screwed to a Gaspero electroscope at a right angle. When this instrument is correctly introduced, the patient readily breathes through it and a complete view of the larynx and trachea may be had.

MEDICAL CONVENTION.

The American Electro-therapeutic Association will hold its fifth annual meeting at the College of Physicians and Surgeons of Ontario, in Toronto, Canada, on Tuesday, Wednesday and Thursday, September 3, 4 and 5. A feature of the meeting, in addition to the interesting papers which will be read, will be an exhibit of modern electrical appliances. A reception will be tendered the visitors by the medical profession of Toronto and other attentions paid to them.

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NEW ELECTRICAL ADAPTATION.

Invention to Augment the Water Supply Systems of Cities—Provides a More Uniform Pressure Throughout the Supplied Districts.

PLAN DEVISED BY J. P. BARRETT, OF CHICAGO.

City Electrician Barrett, of Chicago, has designed for the water supply department of that city a system of auxiliary pumps, that promises to materially, if not completely, relieve those districts that have heretofore suffered from water famine, due to failure of the pumping equipment. The engineers of the water department are busy preparing the detailed plans to carry out Mr. Barrett's ideas.

The designs contemplate a number of sub-pumping stations, at various points, operated by electric motors, that will take the water from the mains and raise it into towers, for further distribution under practically new pressure.

When the idea was first suggested it seemed so simple and so wholly practicable, that many wondered it had not been thought of before. No new inventions are required for the introduction of the change, old principles being used under new conditions for new purposes. It is calculated that it will cost the city of Chicago about half a million dollars to put the new scheme into effect, as against ten times the amount that had been figured on

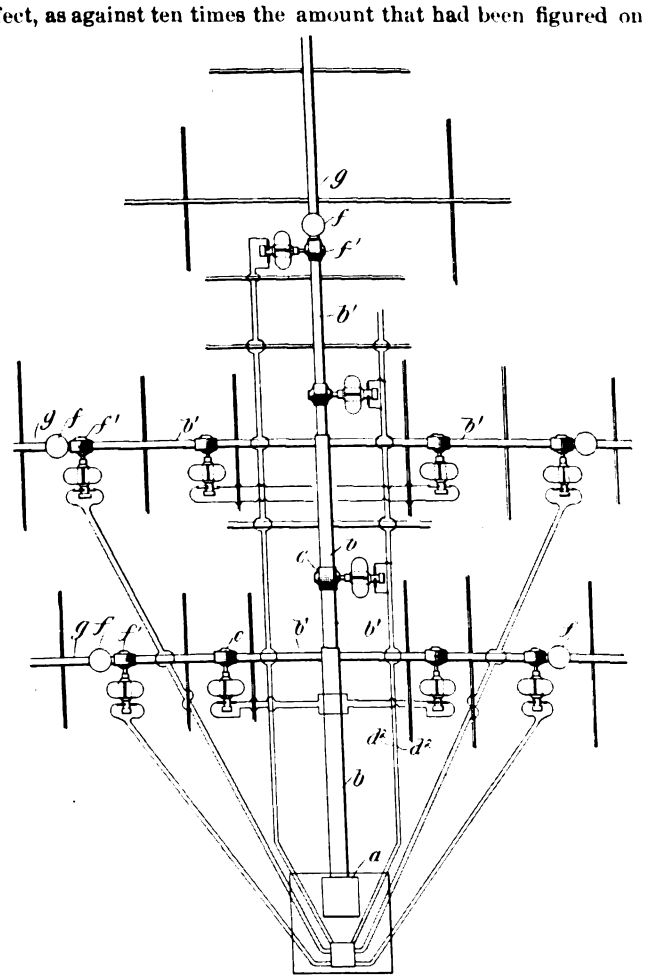

FIG. 1.

by the water department to make the service competent to meet existing and rapidly approaching conditions.

While much has been published about the plan, as a whole, no details have been given until now.

Fig. 1 is a view illustrating an electrically controlled water supply system, equipped after the manner suggested by Mr. Barrett.

Fig. 2 is a diagrammatic view, illustrating the manner in which a central pumping station and a central electrical power station may be employed for securing uniformity of water supply.

Fig. 3 is a diagram illustrating the water supply system of a municipality, in which several central pumping stations are provided, and, further, illustrating the manner in which the power for running the electrically operated pumps may be derived from the electric lighting stations of the municipality.

Like letters refer to like parts in the several figures.

A pump is provided at the central pumping station *a* for forcing the water through the main *b*. At various points along the

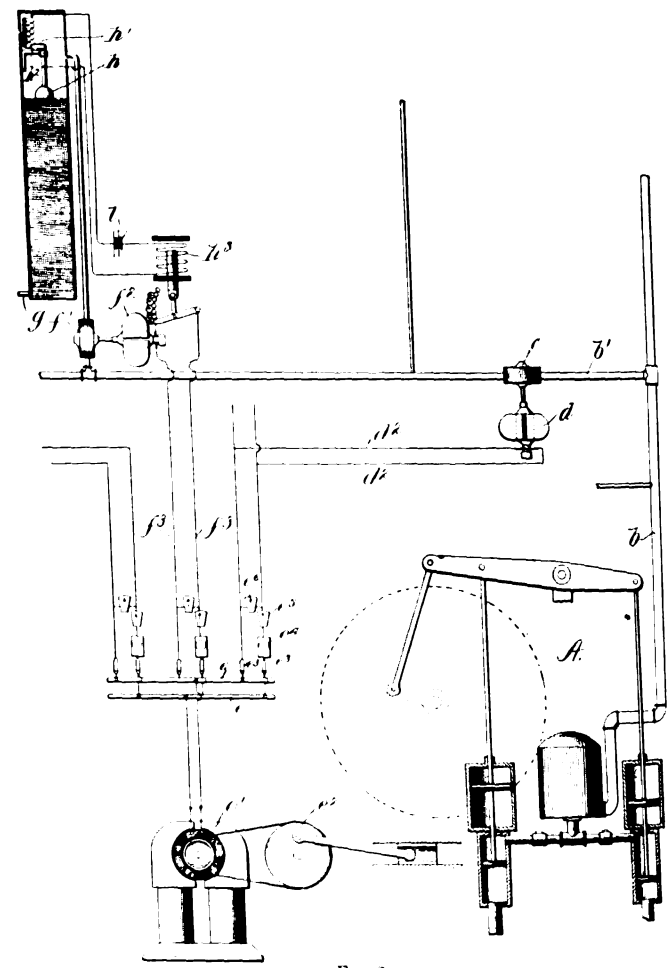

FIG. 2.

mains are provided auxiliary pumps, one of said pumps, c, being illustrated as interposed in the main b^2. The pump may be of any of the usual forms, reciprocating, rotary or of the screw type, as may be found desirable. In the drawing the pump c is illustrated as of the rotary type, the rotating element being mounted upon the armature shaft of the motor *d*. The electric motor is connected by feeding mains d^2 d^2 with the bus bars *e e* at the central power station, and supplied with current from a dynamo or generator *e*, operated by a steam engine e^2. Upon the switchboard at the central station are provided the usual switches e^3 e^3, rheostat e^4 and meters e^5 e^6, whereby the motor *d* may be controlled by the attendant at the central station. A number of motors for operating the pumps may be connected with a single pair of mains, or the motors may be individually connected with the central station. At the centers of distribution of outlying districts are provided tanks or standpipes *f*, a pump f^1 being provided in connection with each standpipe for forcing the water from the main into the standpipe. The pump is illustrated as a rotary pump, the rotating element of which is mounted upon the armature shaft of the motor f^2, the motor being supplied by current from the central power station over the feeding conductors f^3 f^3. The water main *g* supplying the district, is connected with the standpipe *f*, and the pressure throughout the district thus depends upon the head of the water within the tank. The motor f^2 may be controlled by the attend-

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ant at the central power station, and thus operated at will to maintain the water within the tank at the desired level. It is preferable to provide means for automatically controlling the speed and operation of the motor f^2, and in Fig. 1 is illustrated a specific form of controller, which may be employed for this purpose. Within the tank is provided a float h, carrying a contact arm h^1, adapted to move over a series of terminals h^2 connected with a series of resistance coils. The contact arm h^1 and the resistance coils are connected in circuit with a source of electricity h^2 and the winding of a solenoid or electro-magnet h^3. The

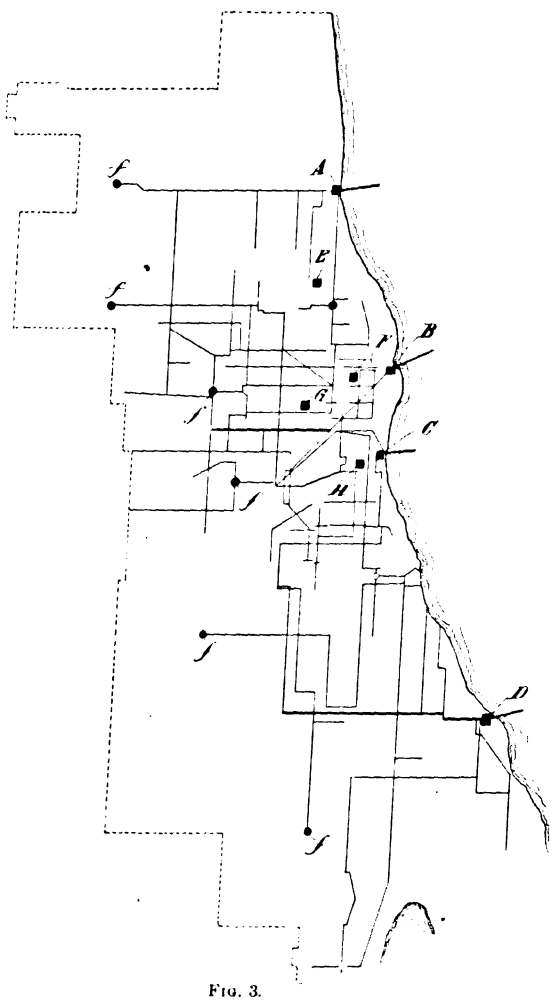

Fig. 3.

core h^4 of the solenoid is connected with a contact arm h^5, adapted to be moved over a series of contacts h^6, which are connected with the resistance coils of a rheostat. As the level of the water within the tank falls, the float h is lowered and moves the contact arm h^1 to cut resistance into the local circuit containing the source of electricity h^2. The attractive effect of the solenoid h^3 is thus decreased, and permits the movement of the contact arm h^5 by means of a spring h^7, to cut resistance out of the motor circuit, and thus increase the speed of the motor, and consequently the volume of water pumped into the standpipe by means of the pump f^1. As the level of the water in the tank rises, the contact arm h^1 is moved over the terminals to cut resistance from the circuit of the source h^2, thus increasing the attractive power of the solenoid h^3, and moving the arm h^5 in a direction to cut resistance into the motor circuit, thus decreasing the speed of the motor. When the water reaches a predetermined level, the contact arm h^1 is moved to cut all of the resistance out of the local circuit containing the source h^1, and the solenoid h^3 is energized to move the contact arm h^5 into a position to open the circuit through the motor, thus bringing the motor to rest. It is evident that other forms of controllers may be employed without departing from the spirit of the mechanism.

In Fig. 2 sub-mains b^1 b^1 are illustrated as extending from the main b to tanks $f f$, located at the centers of distribution of outlying districts, a series of pumps f^1 f^1 being provided, one in connection with each of the tanks, for forcing water from the mains into the tanks, the pumps being operated by the electric motors f^2 f^2, connected with the central station by mains f^3 f^3. Distributing pipes g g extend from the tanks f throughout the districts to be supplied. At points along the mains b b^1 auxiliary pumps c c are provided, the pumps being operated by electric motors d d, connected with the mains d^2 d^2, extending to the central power station.

In Fig. 3 are illustrated the water supply mains of a municipality, a number of central pumping stations A, B, C, D, being provided, while at outlying points are situated tanks $f f$, adapted to supply water to the districts in which they are located. The electrical energy for operating the auxiliary pumps, which are situated at intervals along the mains, and for operating the pumps provided in connection with the several tanks or standpipes, is supplied from central power stations E, F, G, H. By thus providing auxiliary pumps at intervals along the mains, and tanks at outlying points, the pressure at the central stations may be greatly decreased, while a practically uniform pressure may be maintained at all points throughout the supplied districts. Furthermore, the water supply system and the electric lighting system co-act, thus cheapening the cost of furnishing water and electrical energy to the city, since the electrical apparatus of the power stations may be utilized for operating the auxiliary pumps during the day, while they are not in demand for furnishing lighting currents.

IN DARKEST NEW YORK.

It is now about time for the periodic rumor of coming electric light for the elevated trains. Again and again it has been announced that George Gould was about to ratify a contract with the something or other company to shed effulgence in the smoky stations and oil-odorous cars of the Manhattan elevated road. But the rumor remains a rumor, drags out a slow existence and dies a natural death.

There are plans afoot to make an electric motor system practicable for an overhead railway. Indeed, the time seems ripe for such a change. But why the antique oil lamp must be kept alive to witness the death of steam is a question. For New York, of all cities of the world, to bear such a constant annoyance so long is proof that meekness and long suffering are still among its virtues.

Electro-motor engines are all well enough and will come in time, but what the people of New York, who ride in the elevated cars after dark, want now is sufficient light to enable them to recognize one another without making necessary an after course of myopic treatment. Cats, bats and eyeless Mammoth Cave fish might be comfortable in the nightly "L:" man is another kind of animal.—*A New York Exchange.*

ELECTRICITY FOR MICROBES.

Dr. C. C. Wylie has a theory for the extermination of typhoid fever and other germs by the use of electricity, says the Pittsburg Leader. He said last evening:

"Filtering through sand will result in clarification. Water may appear perfectly limpid and yet be full of death. Charcoal added to the sand would go far toward purifying the water, but would not completely do so. The safe plan would be to absolutely destroy all life in the water by the application of electricity. In other words, I would suggest clarification, purification and electrocution. These three combined would give us water from which all dangerous germs would be eradicated.

"How could this be done? Our skilled electricians can certainly devise a way of introducing such an electrical current to a vessel of any size that the desired results will be obtained. It is well known that water is an excellent conductor of the electric fluid, and can be heavily and instantly charged with it. Now it seems to me it would be an easy matter to arrange batteries of sufficient power to electrocute all life, even in a reservoir of sufficient capacity to supply a city. Small but powerful batteries could be operated even by unskilled servants, and the home supply rendered innocuous.

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VOL I. CHICAGO, SEPTEMBER 1, 1895. NO. 7.

The Storage Battery.

Ever since the storage battery was brought to the notice of electricians it has been striving for a place of genuine usefulness in the electrical art.

In theory, it was a most useful invention. The central station, doing the great bulk of its work in a very few hours out of the twenty-four, needed it to balance up the load. The street car needed it, the isolated plant needed it. But it has been before the public for fifteen years and, in this country at least, it has made slow progress. Why?

There is no want of success from the electrical stand-point; electrical energy can be stored and recovered with no unreasonable amount of loss. That has not stood in the way. The drawback has been the great first cost and the rapid deterioration. The latter has been due in this country partly, at least, to the effort to reduce the cost and secure lightness. Some of the batteries of ten years ago would do fair work, if used only to one-third or one-fourth their rated capacity; but the first cost, taking the capacity as rated, was enough to stagger the would-be purchaser. What would it have been if he had been informed that he must use a battery three or four times as large?

The storage battery was tried on the Fourth avenue cars a few years ago without success, owing partially to rapid deterioration, and partially to litigation, that stagnated for a time the entire industry. It was tried also for lighting some of the trains between Boston and New York without success. The patent question has at last been settled, and the Electric Storage Battery Company is now coming forward with what is, no doubt, the best lead plate, lead oxide battery that has yet been offered to the American public. Several plants have already been installed in central stations furnishing light and power, where they are doing good service in balancing the load in the dynamo plant. This company is now preparing to test again the question of the adaptation of the battery to street car propulsion, and the experiment will be watched with the greatest interest.

The question is, which is most advantageous from a commercial point of view, to carry the electrical energy to the cars by a conductor, or to furnish each car as it leaves the station, with energy sufficient to carry it the round trip? Without attempting to go into the question in detail, I would point out a few of the considerations that must be taken account of:

First—The cost of the central station plant for charging batteries would not be much different from that of a plant to run the cars direct. The plant could be somewhat smaller, if batteries enough were furnished, so that the exhausted batteries could be allowed to accumulate during the busy hours, to be charged and stored ready for use when the traffic was light. But such an excess of batteries would cost more than the plant it would save.

Second—Each car must be supplied with motors and controlling devices, precisely as though it were to be driven direct from the central station.

Third—There is the cost of the storage battery equipment to offset the saving in line, and, perhaps, subway. Which of these would be the greater would depend upon the conditions in the given case.

Fourth—The loss of energy would not differ greatly for the two modes of propulsion. For short lines the loss would be against the battery.

Fifth—The cost of maintenance of a storage battery would be much greater than a well constructed line.

Without comparing figures it would seem, as an off-hand guess, that the conditions would need to be all favorable to the storage battery, in order that it might prove its superiority, even to an underground trolley, from a commercial standpoint, upon lines of ordinary length and ordinary density of traffic.

It is stated that the battery now to be tried for street car service has already passed the experimental stage, and is a success in Paris. Granting this, it must not be forgotten that Paris is not New York.

* * *

Profit in Arc Lighting.

A large percentage of the stockholders in arc lighting companies will doubtless maintain that there is no profit in the business under present conditions. That this will continue to be true, to the extent to which it doubtless has been true in the past, can not be shown. Arc lighting has come to stay. The people will have it, and naturally want it as cheaply as they can get it. But the capital necessary for supplying it wants, and is entitled to an adequate return. If capital now invested can not get such return at present prices and with present methods, but could do so with other methods, then one of two things must happen. Better methods must be adopted, or old capital and methods must give way to new.

The most obvious way in which to improve the profit and loss account is to cut down operating expenses—a process which has been carried to the limit in most directions. There is one direction, however, in which the great majority of existing companies can make a substantial decrease in expense.

It is commonly reported that the coal burned to maintain arc lights amounts to from six to nine pounds per lamp hour. Recent data show that in every day work, three pounds per lamp hour are abundant. The explanation is found in the difference between the amount of steam used by engines of the types largely used in the past, and that used by the improved engines of to-day. Engines of the older types use from thirty-five to sixty or more pounds of steam per horse-power-hour, while compound engines, without condensers, use as little as twenty pounds of steam for the same service. The use of condensers, and of triple expansion engines improve the case. Of course these are well-known facts, but they are only just beginning to be felt in the arc lighting field, and it seems likely that the profit and loss question will soon force a general substitution of higher class engines for the present wasteful ones.

Let any station manager, who suffers a possible attack of the

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blues as each annual meeting draws nigh, consider what would be the effect on his balance sheet of splitting his coal bill in two. He will doubtless find it wise business policy to get what he can for his old engines, or throw them away if necessary, and put in new ones of modern type. The saving in coal will soon pay for the new engines, and thereafter contribute to the dividend he is after. Then let him turn his attention to his boilers, piping and firemen. Dirty boilers, small leaks and bad firing waste a deal of coal in a year

Benj. F. Thomas.

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Patent Office Methods.

The comments upon the methods of the U. S. Patent Office, made in this column in the last issue, have aroused unusual interest, and have brought into the editorial office many communications, some of which have been so radical in their endorsement of the position taken by this journal, that there seems to be a necessity to make a somewhat elaborate and more definite statement concerning the issue.

In the first place it must be assumed that there is no malice or viciousness in anything we have written. What has been done is wholly in the interest of electricity as a science and art. In the next place we desire that it be understood that we fully appreciate the many difficulties that beset those who would act for the best interests of the department if they could. Not the least of these difficulties is the withering and baneful effects of politics in the service.

The patent office is a part of the Interior Department, the head of which is a creature of politics—changeable with every administration, and usually a man who knows little about the needs or importance of the department, and whose duties in other directions always overshadow those to the patent office; and whose opportunities to serve either himself or his administration are greater in other directions, so that to him the department means little except in a political sense.

When the commissioner is changed every four years, it naturally follows that he must, for a great part of his time, follow precedent as interpreted by his subalterns—the people to whose incompetencies or worse, it is the desire of this paper to call attention: and it will require the acumen and executive ability of such men as ex-Secretary of the Navy Chandler, or the present Secretary of Agriculture Morton, coupled with their courage, to defeat the ends of a conspiring and wicked clique, bent upon perpetuity of rule.

Another forceful, perhaps the most potent factor for the hurt of the patent office, is the practical enmity of the southern and western representatives in congress—especially in the senate. It has come to be well known that these gentlemen are always to be counted against appropriations for the patent office, and on the unworthy ground that, as the north and east furnish most of the inventors, therefore those sections are the only ones interested in the department. They forget or ignore the fact that the south and west employ these patents and either pay direct royalties for their use, or pay indirectly in the shape of increased prices for commodities in the manufacture of which they have a part. The consequence of all this unwise and short-sighted opposition to the department, however, is that there is now to the credit of the office, and locked in the treasury beyond reach, some six or seven millions of money.

Since this matter was broached in these pages, some valuable information has found its way to the office, and we hope for much more before we finish with the subject.

We have learned that the Interior Department has driven the patent office from pillar to post, until now all, or nearly all, the models have been relegated to a dump in an old out-house, and the offices themselves are the former model rooms.

We learn that there are about 500 patents issued weekly, each one of which costs the inventor $15, beside attorney's fees, making an annual total income to the office of $910,000. If this amount of money is not sufficient to sustain the service, the rates might well be increased or even doubled, if necessary, to employ more and better men. We do not believe there has ever been complaint of the high charges, and if the issuance of a patent carried with it a title to something other than a law suit, we believe there would be no fault found.

If the Commissioner of Patents objects to criticism, and we understand that he does, if he has any plans by which his department may be made really serviceable, we pledge him the pages of this paper and its influence, whatever that may be worth, to help him in their execution.

When we questioned, in our last issue, the practicability of a congressional investigation, we had in mind the unfriendliness of some congressmen, and some senators and the selfish machinations of others.

The time is very ripe for a great big man, with a strong backbone, in the office of Commissioner of Patents, and if he is there now, he may be assured that he will have the whole electrical fraternity to hold up his hands, if he will lead the fight for the inviolability of the American patent.

* * *

The Stationary Engineers.

The convention of the National Association of Stationary Engineers, which takes place at St. Paul, beginning on the 3d of September and lasting four days, promises results that will have a most wholesome effect upon the whole labor world. Wisely the leaders of the association have bent their efforts toward those things best calculated to improve the mental and money-earning capacity of its members, rather than undertake to enforce their position in the industrial community by a demonstration of force, and of offensive "strike" laws.

Judging from its constitution and laws, the primary and, indeed, the sole function of the association is to improve its members.

During the past year the subordinate associations have almost transformed their weekly or monthly meetings into school sessions, or literary meetings, and great good has been accomplished thereby. We learn that a new impetus is to be given to this feature at the coming convention, by plans of work for the coming year that will be directly in line with the business of the members. We also understand that a large contingent of the membership is disposed to minimize the secret work of the order and to encourage strictly educational work. That, we think, will be another advance.

In another of these pages we dilate somewhat upon an expression lately made by a stationary engineer, in effect that electricity bids fair to throw the stationary engineer out of employment, by encroaching upon his field. This matter is mentioned here solely for the purpose of emphasizing the suggestion that progressive men do not sit around idly moaning, "O tempora! O mores!" If they find that times are changing, they gird up their loins, and prepare to change with them. It is true that electricity is entering largely into the field of the stationary engineer, and it is true, without doubt, that presently the stationary engineer who does not know something about the practical side of electricity will be left behind in the race of progress. But it is also true that stationary engineers, as a class, are among the brightest and most intelligent of craftsmen, and they are, moreover, mechanics. These qualifications prepare them to go into the study of electricity with vast advantages over their fellows, and there is no good reason why they may not be among the first to master the principles of electricity so that they may perform intelligently any duty concerning it, that may come to their hands. Let them not bemoan the progress of electricity, but let them take advantage of the signs of the times to prepare for its coming. And if it is proper that stationary engineers should study electricity, it is also fundamentally necessary that the National Association of Stationary Engineers shall give out the edict to that effect.

There is one point upon which we would rivet the attention

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of the association, and that is that a very large contingent of the craft is still outside of, and not in harmony with the association. And even within the order there are too many small, weak associations, and far too few large, strong ones. "In unity there is strength" is old and trite, but it is true and pointed, and they who appreciate it, are preparing against attack from without, and strengthening the position of those within. We do not know the reasons why there are so many engineers who are not members of the association, and it would be impertinent in us to inquire, but we may, in the heartiest good friendship, suggest the condition to the officers and leaders for their consideration.

In their deliberations at St. Paul, the delegates should not fo get that they are leaders in labor thought—not that rabid, hot-headed kind that breeds agitation and turbulence, but the sober, earnest kind, that builds up principles and perpetuates order and prosperity. As the stationary engineers do, so will other organizations do, and a knowledge of this fact must carry with it responsibility.

We do not offer advice in the spirit of interference, but we recognize the importance of this meeting, and we fully appreciate the power for good that the National Association of Stationary Engineers can exert upon the whole country, and we stand for prosperity, peace and harmony in effort and achievement.

* * *

Engineers and Electricity.

A stationary engineer of Omaha has become quite exercised over the possible outcome of the application of electricity to power purposes. He has pictured to himself a time in the near future when steam will be displaced by electricity, and when the stationary engineer will be of no more practical use to the community than the lamented street car horse. We hasten to assure the gentleman that he is unnecessarily alarmed, that he is borrowing trouble too remote for consideration. There is, we are happy to assume, no immediate probability of intelligent engineers, as a body, being thrown upon the cold and relentless charity of a selfish and unfeeling world. In the first place, conceding that electricity will displace steam for many purposes, the change is not going to be of that instantaneous character which is the boast of the lightning change artist, and, besides, a great deal has yet to be accomplished in the field of electricity before steam makes its exit. Should the worst come to the worst, however, there is no more intelligent body of men anywhere to be found than the stationary engineers, and they can be trusted to adjust themselves to changing circumstances. What progressive engineers should do, and what they are doing, is to post themselves as thoroughly as they can on the principles and applications of electricity, so that when the necessity for such knowledge presents itself they will be ready for the occasion. There will be a great many good openings as the applications of electricity become more general, and a corresponding demand for capable men to fill them; the very knowledge which a stationary engineer possesses, coupled with the electrical knowledge which he can obtain, will qualify him to hold his own against all comers.

* * *

Electrical Workers' Boycott.

Information comes by way of Washington, D. C., that the officers of the National Brotherhood of Electrical Workers have declared a boycott against the Atlanta exposition, on the ground that convict labor was employed in part in its building. They have urged all their members to refrain from attendance at the exposition.

We have known the officers of that association to do some extremely unwise things, and we are fully persuaded that the utter want of influence of the association is due to the same unwisdom. This last move is the acme of folly—in the first place because it will fail of its object, and any move is foolish that is stamped with failure at its outset. It ought to fail, because its purpose is coercion, and coercion is un-American, and is unfair fighting. Moreover, it sets a pace that will tend at least to pledge the association to the principle of *force*, the very thing that the association is organized to combat, if it is organized for any well matured purpose.

Up to the present time the National Brotherhood of Electrical Workers has not impressed itself upon any community, and it is just because of such weak management as this Atlanta movement indicates. The association has elements of strength and ought to be strong, but it will not be so until its policies are materially altered.

* * *

The Rotary Field.

It will be observed that the number of reading pages of THE ELECTRICAL JOURNAL is increased in this issue by the addition of four pages. This course was made necessary by the length of the article by Professor Carhart on the "rotary field." We regard the subject treated in this article as of great importance, and we are quite sure that our readers will appreciate the effort on our part to present the paper in its entirety, in one issue rather than in parts. The large number of photographs occupy most of the space, the matter itself being compact and direct. The matter of the paper is self-assertive, and is mentioned in this place only to direct attention to the fact that readers of THE ELECTRICAL JOURNAL may expect not only the best matter obtainable, but that they may expect also that the general electrical news and events of the day will not be neglected to make room for special matter of this kind, but that our reading pages will be increased when necessary.

* * *

Weed Killing.

In this issue we take up the thread of a subject dropped by the July Cosmopolitan, namely, the destruction of weeds by electricity. Prof. A. E. Dolbear, of Tuft's college, whose articles on this and a variety of subjects, have attracted so great an interest to that magazine, becomes a contributor to the columns of THE ELECTRICAL JOURNAL and wisely chooses a subject for his initial article that has already attracted attention.

Up to the present time no real attempt has been made in behalf of the farmer, and against his natural enemy the weed, but, as Prof. Dolbear aptly says, there is no reason why such an attempt should not be successful. In supplement of what Prof. Dolbear writes, we have asked for and obtained a contribution, precisely to the point, by Mr. Chas. E. Armstrong, of Chicago, than whom no one is more familiar with the subject, and whose work in this field of electricity has been special and practical.

We are quite sure the subject will be of interest to our readers.

* * *

Look Alive, Neighbor!

We feel constrained to advise our worthy contemporary, the Western Electrician, that, in its zeal for the protection of the Chicago public against the machinations and monstrous outrages of City Electrician Barrett, it has missed one of the most important pieces of electrical news we have had during the dog days. We refer, of course, to the announcement of plans for the improvement of Chicago's water supply, by the addition of auxiliary pumping stations to be worked by electric motors.

Brother Kreidler will be after his young men with a sharp stick unless they are more alert.

* * *

Vice-president Pugh, of the Pennsylvania railroad, is quoted as saying that electricity will never be the motive power to propel trunk line trains, because people do not want to travel ninety miles an hour. Why is it then that the Pennsylvania limited train between Chicago and New York had practically a monopoly of the first-class business for so many years, and lost it only when the New York Central gave faster time and better service? Unless we are badly informed the plans now in course of developement by the latter will give Mr. Pugh a fine opportunity to test his judgment.

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A microphone arrangement, to be placed over the cot of sleeping babies, is designed to benefit the poor, who are obliged to work in other parts of the house while their babies are sleeping in darkened and quiet rooms. Now, if they will connect this microphone with some central conservatory of music, so that when babes awaken they may be heard and sung to sleep again, the innovation will be complete. Why should the scientist concern himself about the expense. That is something for the poor to wrestle with.

The women in Detroit are now going to run the trolley cars. One of these days "lovely woman" will deny us lords of creation the privilege of working at anything, and we will be again in that elysian and primeval condition now monopolized by the noble red man, whose squaws are accorded the eagerly sought privilege of doing all the work.

If the New York law, to punish telephone girls with a $1,000 fine and imprisonment for six months for divulging secrets heard over the line, is intended to fix a specific value on secrets, then the girls will be readily able to appreciate the necessity of telling them as soon as possible. Secrets worth that much are entirely too good to keep.

It will be noticed that the steam railroad managers are kept pretty busy these days explaining why it is impossible for electricity to supplant steam for trunk line service. About this time five years ago the horse car and cable people were trying to sweep back the same sea.

The women of Detroit have petitioned the trolley line managers to allow them to operate the lines for one day, in the interest of charity. They will act as motor men and conductors. "Whom the gods would destroy, they first make mad."

We may now look for our hysterical contemporaries, the daily press, to go into conniption fits over the introduction of trolley funeral trains. They will, undoubtedly, suggest "the inadequacy of other means of burial since the deadly trolley," etc.

Why not? A trolley line is being built to the Garden of the Gods, and we think it meet to carry the dead on that kind of road. Some people we know will never get into that locality—when they die, in any other way.

We have always heard that the New York telephone girls were independent, but if they are in shape to submit to a $1,000 fine every time they divulge a secret, we need go no further to learn the reason.

We notice Professor Barrett's active interest in Chicago's water supply began the day that the whisky trust was sold under the hammer. Merely a coincidence but significant.

We would give much to be on hand when the new woman of Detroit attempts to do the motorman act. The sight will be worth all it will cost, both to life and property.

It is understood that President Cleveland will open the Atlanta Exposition from Buzzard's Bay, by means of a buzzer.

SEVENTY FEET UNDERGROUND.

A regular up-to-date electric railroad is that of the City and South London, London, England, and in two particulars it may be called unique. To commence with, it was the first specimen of heavy electric engineering in Great Britain, and although only a suburban line of three and one-fourth miles in length, runs full sized trains, and has carried 6,250,000 passengers each year since it was opened, in November, 1890.

Another point about this road is the fact that it is seventy feet below the surface of the ground, thus avoiding all difficulties connected with street traffic on the surface and the encountering of sewers, gas pipes, water pipes, etc., below the surface—a great point gained when it is a question of a crowded city. The lines are laid in two iron tubes, which follow the direction of the main thoroughfares above. The tunnels were excavated and the tubes put in without tearing up the streets at any point, except where the stations were put in.—*Detroit Free Press.*

IRVING ROUSE PRENTISS.

The subject of this sketch was born sometime prior to the year 1881, and, although he pleads extreme youth in extenuation of many short comings, it may be safely said that he thoroughly appreciates the difference between a "hawk and a handsaw." His career began, and comes down to date, with the Brush Electric Company, his ground plan being coincident with the old storage battery days of that corporation. He spent some three years selling and setting up storage battery plants, and in that capacity acquired the experience which has so pre-eminently fitted him for his subsequent occupation as jack-of-all-trades for his company. His duties vary. Sometimes he enjoys the disingenuous calling of sales agent, than whom no one is blander. Again, his predilections take him into the ante-rooms of city councils, where his ability to figure out the carrying capacity of "wires" has made his services invaluable. Sometimes he is purely an electrical expert, and is engaged in the various branches of that calling throughout the country. During the World's Fair those in charge of the electrical department learned to value his mathematical skill, as he could always be counted on to figure out any result desired from any sort of beginning. But wherever Mr. Prentiss is placed, no matter how trying the conditions, all who have ever had dealings with him know him to be one of the biggest hearted and whitest men in the electrical or any other profession. He knows, perhaps, as many men as any other man in the country, and if he has ever lost a friend no one has ever been able to find him.

There has been tested recently, near Gratz, in Austria, an electric target, invented by Felix Mauthner, an Austrian captain, and Fritz Figlovsky, engineer. This target presents the advantage of rendering unnecessary the presence of a man to indicate the hits. In fact, whatever the range, the target, as soon as it is hit by the projectile, gives a signal which is registered by an indicator placed near the stand. To effect this, the stand and the target are connected by a cable. The target is made in the usual form, and consists of meshes of wire tolerably close together; it is, further, of a bright color. As soon as the figure or the wire rings that represent the upper part of a man's body, are hit by a ball, the circuit closes and the bell placed near the stand is heard; this ringing is accompanied by a signal visible on the indicator. The apparatus, which is connected with the target, is placed underground and requires no care for its maintenance.—*Boston Transcript.*

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KILLING WEEDS BY ELECTRICITY.

Apparatus in Successful Operation on Railroads—Practical Application Wanted for Agricultural Purposes—Would be a Boon to the Farmer.

OPENS UP A GOOD FIELD FOR MANUFACTURERS

In the Cosmopolitan Magazine for August I have described a "weed-killer" operated by electricity, and said to be employed to destroy weeds along railroad tracks. I suggested that a device similar to it could easily be adopted to kill weeds in fields, such as thistles and the like. Since that article was published I have received numerous inquiries from all parts of the country asking for more instruction as to where such machines are to be had, and the cost, etc. As I do not know of any manufactory in the country where they are made, and as the demand for them appears to be considerable, it occurs to me to point out to electrical manufacturing companies the desirability of doing something in this line. A man in the State of Michigan writes that if he could kill out the kind of coarse grass growing on a large swampy tract, the land would be increased in value fifty times. Another one in Texas is troubled by a plant, having juicy stalks and roots, which is so difficult to eradicate that if a bit of root is left in the ground it starts a new stalk. Another in California has orchard weeds he would kill, and wants to know if an ammonium chloride battery will answer.

Now for such work as this it is needful to have at hand a good supply of electrical energy. For heavy weeds probably four or five thousand volts will be necessary, if a single discharge lasting no longer than a second is to do the work. A truck or wagon, carrying eight or ten secondary cells with a mechanical alternator and a high voltage transformer, would be feasible for some places. An alternating dynamo could also be drawn by a two-horse team with proper mechanism, and with a transformer could discharge through weeds or grass. For larger fields it would be possible, and worth the while, to fix a portable steam engine and alternating dynamo at some convenient place and let a trailing cable run from it to a truck drawn by one or two horses, carrying the proper transformer and discharging teeth. One might, in that way, have eight or ten electrical horse-power at disposal at ten thousand or more volts, and this would make short work of ridding a large area, for acres could be covered by it in one day. Of course the best time for doing such work would be in dry weather, when the chief conducting material would be the juices of the plant itself, and the disruption that would follow would continue to the tips of the roots.

It is to be hoped that some enterprising company will undertake to supply the country with the proper apparatus. All the necessary parts are invented and well known. They only need to be assembled for this particular work. In every neighborhood such apparatus is needed, and a single portable plant would have plenty of work in fields of all sorts.

A. E. DOLBEAR.

THE RAILROAD WEED KILLER.

Description of the Electrical Machine which Destroys Vegetation at the Rate of Sixty Miles a Day.

A number of articles have appeared in various papers and magazines relative to the extermination of vegetation by means of electricity. As the writer had the pleasure of developing this machine, and also of conducting a large number of very interesting experiments with the same, he feels that it would not be amiss at this time to explain, through the medium of your valued journal, some of the results obtained in said experiments.

The importance of exterminating weeds and grass upon railroad tracks cannot be understood by the general public, as it is probably not known by many, but it is a fact, nevertheless, that such vegetation interferes largely with the operation of the trains and adds greatly to the expense of repairs, etc., especially in the warm or semi-tropical countries. Grass and weeds, growing up around the rails, are caught by the wheels and ground to a pulp, which, together with the grease which has been wiped from the boxes of the passing cars, becomes an excellent lubricant, necessitating the use of large quantities of sand and a corresponding destruction of the rails. Trains are often completely stalled by meeting a patch of this grass. For this reason it must be entirely removed from the vicinity of the rail, because, even if not within touch when upright, it is apt to be blown over and caught by the wheels, which act is liable to be followed by disastrous results. Railroad companies throughout the United States have found that, to remove these grasses and weeds, it costs an average of forty dollars per mile a year. In Mexico and South America the cost runs very much in excess of this amount.

Capt. A. A. Sharp, superintendent of the Yazoo division of the Illinois Central railroad, a man of scientific turn of mind and a close observer, who is the discoverer and inventor of the apparatus described herein, found the cost of killing the grass and weeds from the railroad tracks such a serious one that the question of some improved method suggested itself to him. The process which he was employing, and which is being employed to-day by all railroad companies, was to chop the grass and weeds with shovels and throw them from the track, a laborious and expensive proceeding, not alone from first cost, but from the fact that some of the ballast is also thrown off with each shovel of weeds, necessitating, in a short time, reballasting of the entire road.

Capt. Sharp noticed, in the course of his labors, that when a telegraph wire sagged down upon the willow trees along his line, it gradually but surely killed the same. He immediately began a series of experiments, assisted by a prominent Memphis electrician, Mr. F. E. Boardman. The result of their researches was that the captain took out a patent for a process for destroying vegetation by electricity. The writer was engaged to develop the machine for the Illinois Central Railroad Company.

After a series of experiments meeting with more or less success, a machine was developed, which I shall attempt to describe.

An ordinary high-speed automatic engine was placed in a box car, belted to an alternating dynamo of about 60 kilowatts capacity, to which were connected an ordinary switch board and station instruments. A line was carried from this plant to a flat car, upon which were located eight step-up transformers. Immediately behind the box car was a locomotive, the boiler of the engine being connected with a steam pipe to the high-speed engine. The transformers were of a special form, made with a view to high insulation, and were each placed in half barrels and completely covered with ordinary coal oil. The writer used a great many grades of transformer and other heavy oils, but finally found coal oil to be far superior to any other, from the fact that, in case of a static spark passing through the oil with the heavier grades, it formed a carbon pencil, which the current quickly followed through, carbonizing more oil, until it formed for itself practically a short circuit; but the coal oil was so thin that a spark passing through could not form a pencil, as it would be quickly washed away by a rush of oil from that spot, caused by the heat from the discharge. In no single case did a short circuit occur in any of the eight transformers where coal oil was used, whereas, in every case, short circuits were formed with the other qualities of oil.

One side of the transformers was grounded to the frame work of the car, and necessarily to the rails through the wheels and thence to the ground. Extending over the end of the flat car, and worked by long wood handles, carefully soaked in insulating compound, was a brush extending across the track, the length of the ties. This brush was formed by adding together short sections of street car track brushes. It was

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made in three sections, and connected to the transformer separately. This brush was connected to the opposite side of the transformer by a flexible cable, immersed in oil. The brush was controlled by the handles previously mentioned, by which the brushes could be raised to pass over frogs, crossings, etc., and raised or lowered to correspond with the length of grass or weeds to be treated. A sufficient number of fuses, automatic cutouts, etc., were interposed between the main line and the transformers, to protect from accident. The apparatus was then pushed along the track by means of the locomotive and steam furnished to the high-speed engine by the boiler of the same.

The current was then turned on, the secondary or high tension current being at a pressure of 40,000 volts. This was ascertained by measuring the transformers separately by a Thompson static volt meter. Immediately upon turning on the current, a myriad of small arcs were established between the points of the brush and the weeds and grass underneath the same. The experiment was a very interesting and instructive one. The strength of the various arcs varied in proportion to the juiciness or moisture of the various plants treated, but in every case the plant was destroyed. On first passing over, all of the more succulent ones immediately fell, just as a sensitive plant falls after being touched by the fingers, and in an hour's time were black and dead. The more sturdy plants, such as the dew-berry and black berry bushes, showed very little effect until the day following, when they were all dead. By microscopic examination it seemed that the cellular structure of the plants was broken down by the passage of the current in some cases, and in others the plants were simply cooked, even to the minutest root. Very few of the plants, after being touched by the brush, could be handled for a few moments, as they all became very hot under the treatment. The roots, when pulled from the ground, were so hot they could not be held in the hand. Milk weeds, rag weeds, and thistles seemed to succumb very quickly to the electric influence. The hardiest substance met with was the Bermuda grass, a very thick grass with many roots: spreading plants and vines, such as morning glories, which have but few roots, were very quickly killed, as the root is the best path to earth and necessarily receives the largest quantity of current. In this connection it would become apparent why the brush was divided into sections; the vegetation is not always of even thickness on both sides of the track; the current naturally seeking the easiest path would be inclined to rush to one end or the other of the brush. By the system of sectioning this was obviated to a large extent.

The voltage required was found to vary greatly with the character of the vegetation to be destroyed and the moisture of the earth. In many cases, especially while vegetation was quite young, 5,000 volts were found to be ample; later in the season it required 10,000, 15,000 and 20,000 volts to accomplish the same results; and still later, as high as 40,000 volts were used. But the writer is of the belief that for practical operations between 5,000 and 20,000 volts would be the correct amount.

A machine of proper size can easily kill the weeds on a railroad track at the rate of sixty miles a day, working ten hours. To accomplish this by the old method would cost $2,400, while with this method it would not exceed $200, allowing interest, depreciation in the car, the pay of a full gang of train-men accompanying the machine, and trained electricians to work it.

The writer believes this plant to be a very valuable one for the extermination, not only of the vegetation on railroad tracks, but for agricultural purposes, especially the extermination of obnoxious weeds and grasses, such as the "cocoa" grass, Canadian thistles and gypsum weeds. On morning glories the apparatus would have to be modified somewhat; probably a trolley system would be the best to be used, the generator to remain stationary at one side of the field, the transformer only being drawn back and forth on some device similar to a hay rake. Owing to the high tension of current used, this machine would have to be handled by people who were experts in that business, but when so used, I believe it will prove itself to be one of these inestimable blessings to mankind, so many of which have been furnished us of late through that wonderful and all-powerful agency, *electricity*.

CHAS. G. ARMSTRONG.

REVERSED POLARITY.

Engineers in charge of electric light machines are sometimes at a loss to understand what has caused the change of polarity of the machine, when such a thing does happen. There are but few causes that will produce this, and if they are known such annoying results can be guarded against. Exciters for large generators are more liable to reversal of polarity of the field than are the larger machines, the cause being due, in some cases, to opening the circuit of the exciter to throw the load off the large machine, as when shutting down. The discharging of the field, due to reaction of the magnets, will throw the extra current, a current of higher electro-motive force, through the field in the opposite direction. This will change the polarity of the residual magnetism in the field of the exciter with the consequence that, when the machine is again started up, the current will flow in a direction opposite to that intended. This has often been the case with the exciters feeding self-regulating alternators, where a portion of a current from the alternator has been straightened or made continuous, and used to supply the fields producing automatic regulation. With the polarity of the exciter reversed, the current from it works in opposition to that taken from the alternator, and results in lowering the magnetism of the field. To overcome this effect, it is generally found easier to change the lead wires between exciter and alternator than to try to again reverse the polarity by other methods; although the polarity has sometimes been reversed by simply opening the exciter circuit quickly, thus employing the same means for again reversing as that by which the change of polarity had first been produced.

Machines connected in series or in parallel will sometimes, through carelessness, or oversight (all accidents are due to carelessness or ignorance of some one) have the polarity reversed by throwing the machines together under improper conditions or when wrongly connected. Sometimes a machine will be connected to the switch board in an improper way because, perhaps, it is not to be used just at that time, and it is such careless methods that cause much trouble about electric light plants.

If a dynamo is wrongly connected to the switch-board and current is sent through the machine a reversal of polarity follows as a natural consequence. The same method may be employed for changing the polarity of a machine after it has been accidentally reversed, or if for any reason it is necessary to change it from the polarity originally given. Sometimes this becomes necessary, in order to make the working of two machines symmetrical on account of the location, wiring, etc.

Where two machines are connected in multiple, the polarity of one may become reversed if it is not producing so high a potential as the other. Two machines thus working together, even at different potentials, will both supply current to the line, unless the weaker machine is producing so low an electro-motive force that it is wholly overcome by the stronger one. What might be called the neutral potential of the weaker machine, that is, when the ammeter connected with that machine stands at zero, the machine then sending no current to the line is the point below which a reversal of polarity can easily take place. Where both machines are supplied with rheostats, it will be found that the weaker machine becomes neutral, when about half the amount of resistance is thrown out of the field circuit that is usually required when the machine is working at its full potential in multiple with the other.

By understanding the principles and considering the conditions described above, it is easy to understand some of the causes by which the polarity of dynamos are reversed; how they may again be changed can be easily understood from a study of the conditions and by applying the proper remedy.—*The Stationary Engineer.*

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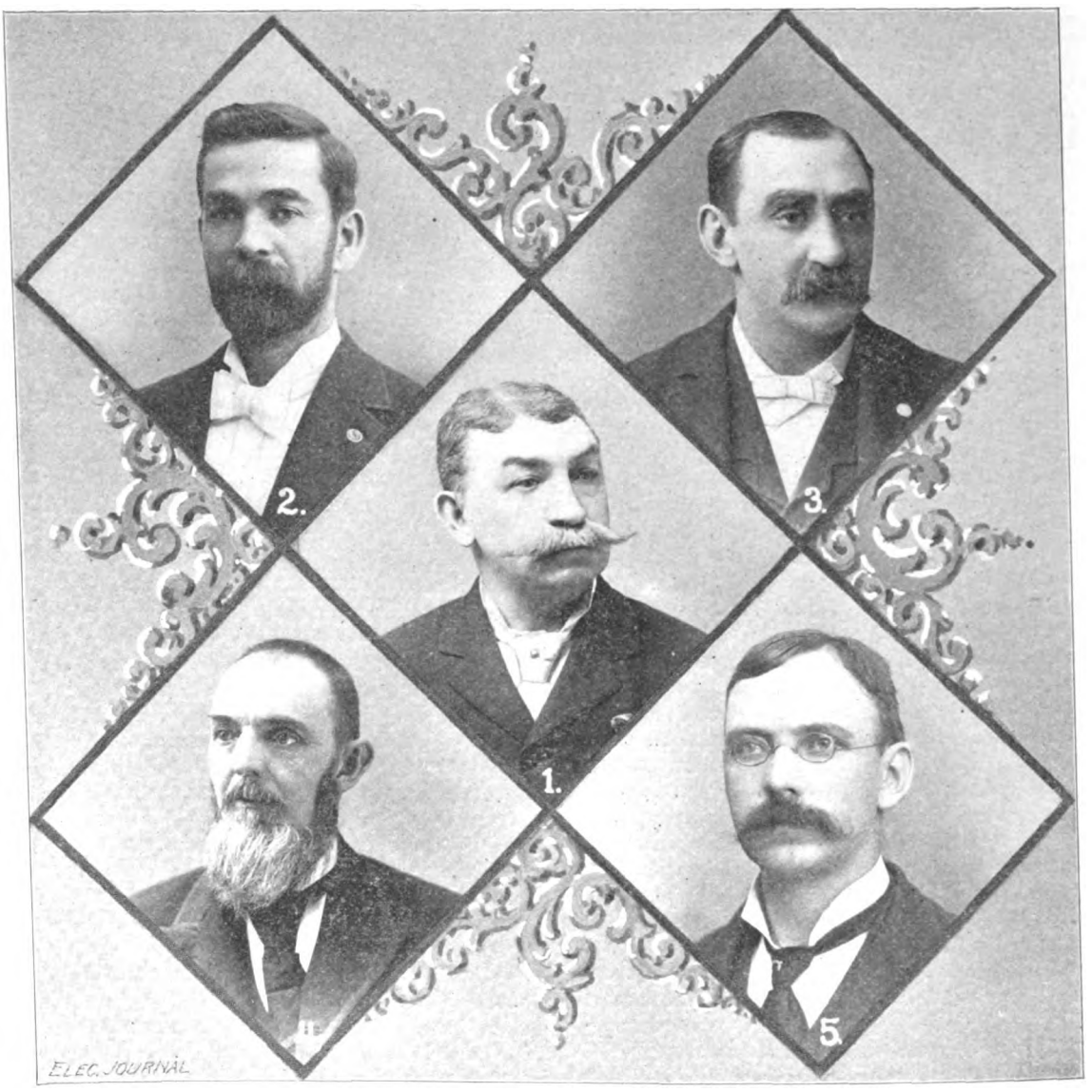
STATIONARY ENGINEERS' CONVENTION.

Annual Meeting at St. Paul—Four Days' Session—Combination of Business and Pleasure.

The National Association of Stationary Engineers will hold its annual convention this year in St. Paul on September 3, 4, 5 and 6. There will be a large attendance of delegates and members. The Eastern and Middle States' delegations will be met on their arrival at the depot Monday evening, September 2, by representatives of St. Paul and Minneapolis associations and escorted, with bands of music, to the headquarters at Hotel Ryan. On Tuesday morning, at 9 o'clock, the delegates will form in line in front of the hotel, ladies and officers in carriages, and with band and platoon of police will make a short parade through the principal streets of the city to Convention Hall, where they will be received, welcomed and addressed by the Governor of Minnesota and the Mayor of St. Paul, to whose addresses Past-National President James G. Beckerleg and representative James G. Harris, of Chicago No. 1, will respond on behalf of the National Association. Tuesday afternoon will be devoted to regular session business and the evening to the life and accident insurance features of the association, the meeting being held in hall of St. Paul No. 7, N. A. S. E. Wednesday will be occupied by regular sessions, and on Wednesday evening a reception will be held and a ball given at the Hotel Ryan. Thursday has been set apart as a day of enjoyment. Minneapolis Association No. 2, will entertain on that day the delegates and guests to an excursion, and in the evening a banquet will be given. Friday will witness the completion of the association's work and adjournment. The present officers of the association are M. D. Nagle, of New York City, President; C. H. Garlick, Pittsburgh, Pa., First Vice-President; John Lane, Providence, R. I., Second Vice-President; C. H. Osborn, Chicago, Third Vice-President; Wm. H. Cronley, Jersey City, Secretary; George S. Flora, Cincinnati, Treasurer; L. Morbes, Milwaukee, Conductor; and C. S. Dill, Goshen, Ind., Doorkeeper. These officers have labored efficiently for the success of the order during their term of office and have had the gratification this year of seeing twenty-two new associations added to the list, and the work, in general, progress in a most satisfactory manner.

Among other matters of special interest to the convention will be the consideration of a new constitution, which has been prepared by a special committee appointed a year ago. The next place of meeting will also be contended for by two or three prominent cities. Buffalo aspires to the honor, and promises the largest exhibition of steam and electrical appliances and engineering specialties ever exhibited at any previous association convention.

A GROUP OF OFFICERS.



C. H. GARLICK, Vice-President.

C. H. OSBORN, Vice President.

M. D. NAGLE, President.

GEORGE S. FLORA, Treasurer.

C. S. DILL, Doorkeeper.

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It holds out, also, a trip to Niagara, where the greatest power plant in the world has been erected for the manufacture and distribution of electric power.

The National Association of Stationary Engineers has now been in existence fifteen years and aggregates a membership of fully 12,000, the members being among the most progressive and intelligent stationary engineers of the country from Maine to California. The forthcoming convention promises to be quite an interesting one. Several matters of importance will be brought up for consideration, and, besides, the election of officers for the ensuing year is likely to call forth a little rivalry. The names of vice-presidents C. H. Garlick and C. H. Osborn have been mentioned for the office of president. Mr. Wm. H. Cronley, of Jersey City, and Mr. G. L. Flora, of Cincinnati, who have satisfactorily performed their duties as secretary and treasurer respectively, would make worthy successors to themselves, and have been scheduled for re-election.

The members of the National Association have a justifiable pride in their organization. It is founded on a set of principles which it would be difficult to improve on, and the influence of the association upon its members is decidedly in the direction of placing them upon a higher plane of usefulness, not only to themselves but to the community at large. A man to become a member of the association must first be an American citizen, or have at least declared his intention to become such, and he must be a duly qualified engineer and have proved himself by a proper examination. The association has certain well defined lines upon which it operates. It cannot be used in the furtherance of strikes, nor will it interfere between its members and their employers in regard to wages. It believes in the policy of labor selling itself to the highest bidder, but aims to gain that result by education and fitness for higher positions and better remuneration rather than by concerted action in the direction of strikes. It aims also to secure proper legislation in the different states with a view to allowing only bona fide engineers to take charge of steam plants.

At the regular weekly sessions of the branch associations, after the regular business has been transacted, the meeting takes on the character of a school room, where special instruction is given, including blackboard exercises in the solving of problems, the reading of papers, etc., and discussions on topics of general interest. This is a most important and necessary feature of association work, and is recognized as such by the members. In no other calling is there at the present time more need for study of new developments than in the so-called stationary engineering. The time was when stationary engineering had to do specially with the handling of steam plants, now it means a great deal more. A stationary engineer today, in order to meet the requirements of a first-class position, must be something of an electrician also, and hence the educational feature of the association is one which has a wide scope, and which will contribute as much as any other single feature can to the advancement of the interests of the engineers as a body.

In view of the candidacy of Mr. Garlich and Mr. Osborn for the presidency of the association, a brief biographical sketch of their lives will be interesting, though they are both well known and have already been honored by election to the office of vice-president.

CHARLES H. GARLICH.

Mr. Garlich was born in Ohio, in 1859, and is consequently now just at that time of life when one's best energies are available for any undertaking in hand. Starting out with only a modest school education, he first commenced to work in a rolling mill, afterwards learning the cooper trade, working in that capacity until 1881. Later, he entered the employ of the Pittsburg Plate Glass Company, during which time he worked evenings to perfect himself in important elementary subjects, which have served as the foundation for subsequent successes. In 1887 he was engineer in the Keystone Bridge Works, and afterwards was chief engineer with the National Rolling Mills of the National Tube Works Co., McKeesport, Pa. At present Mr. Garlich has charge of the mechanical department of the Howard Plate Glass Company, of Duquesne, Pa., and by reason of his expert engineering ability, is frequently called to various plants as consulting engineer. He has made a careful study of mechanical and electrical engineering, and possesses one of the largest mechanical libraries in the country.

Mr. Garlich was married in 1878, to Miss Sadie Griffith, and now has two children, a daughter of 15 and a son of 13 years.

CHARLES H. OSBORN.

Mr. Osborn was born at Troy, N. Y., in 1844, where he lived until 13 years of age, when, with his parents, he moved to Chicago, and proceeded at that early age to carve out a future for himself. When President Lincoln issued his first call for 75,000 volunteers he found himself carried away by a patriotic sentiment, and at once enlisted for three years service in Company A of the the 72d Illinois Regiment. During the war he was in the thickest of the engagements, acquitting himself with credit throughout. On his discharge from the army he returned to Chicago, where he was confronted with the problem of making a living for himself. Without money, without a definite trade, and with only a limited education, for his early opportunities had been limited, he was somewhat at a disadvantage, but an opportunity presented itself for him to learn the machinists' trade; he accepted, but after working at it for a year he was transferred to the engine room as assistant engineer, subsequently being advanced to the position of engineer, which he held for three years. He then joined the fire brigade, but not finding the work congenial returned to engineering, accepting a position with Dane, Westlake & Covertson. His last change was to go with the Henry Disston Saw Works, where for the past eighteen years he has served continuously as engineer. Mr. Osborn is a member in several fraternal orders, and three consecutive times has served as a delegate to the National association, and at the present time is one of the vice-presidents. By steady application and frugal living he has acquired a respectable competency. Unassuming in his demeanor and genial in his disposition he has many friends, who will delight to see him honored as his worth deserves.

ELECTRIC SWITCH.

An invention, which promises to revolutionize street railway switching, was tested at the central market house, a few days ago, in the presence of a group of local street railway officials, says the Cleveland Press. The invention is known as an electrical switch, and it is considered one of the most important arrangements ever brought to the attention of street railway men.

By its use the motor-man of a car is relieved of the trouble of turning the switches along the line. He does not have anything to do but keep the current of electricity turned on. The electrical switch does the rest. The switches, which are reversible and rest upon a cylinder, are turned by an electric current supplied when the car passes under a trolley pan, of which there are two. At the test the first pan turned the switch in the proper position for the Woodland avenue track, and the second switch turned it for the Central viaduct. If the motor-man wanted to go on the Woodland avenue track he turned on the current when the car trolley was passing along the first pan, and if he wanted to go over the Central viaduct, he shut off the current at the first pan and turned it on when he came to the second pan.

The switch is operated by two immense magnets, which are suspended near the top of a trolley-supporting pole, and which are fed by an electric current supplied by a wire connected with the trolley pans.

The switches have been in use by Cleveland railways for several months, but the electrical attachment was not utilized, for the reason that the officials were afraid it would not work. J. Y. Porter is the inventor.

The first practical application of electricity generated by the water power of Niagara to industrial pursuits was made last week, when the first batch of aluminium was turned out from the Pittsburg Reduction Company's new works here.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students. Personal and Pertinent.

THE EXAMINATIONS.

The marking of examination papers of last year's students is being completed very rapidly now, and within a week all who tried the examination will be notified of their standing, and their papers will be returned to them, in order that they may be advised as to their shortcomings. At the present time we are enabled to give the percentages of those who were successful in the following classes, it being understood that an average of 70 per cent. is necessary to entitle the student to a certificate of scholarship:

CHICAGO CITY RAILWAY CLASS.

Wm. Morrison.....5550 Wabash Ave.
James Cross.....4510 Evans Ave.

ENGLEWOOD CLASS.

Archie T. Wheeler.....7749 Emerald Ave.
F. P. McIntosh.....6521 Wright St.
Geo. E. Sanford.....6330 Wright St.

OAK PARK CLASS (Oak Park, Ill.)

J. W. Luce.....Oak Park.
F. M. Pebbles.....377 Ann St.
D. P. Robinson.....Maywood.
W. H. Andrews.....320 Maple Ave.
John C. Smith.....403 Chicago Ave.

OAKLAND CLASS (Chicago).

A. Fontaigne.....3210 Forest Ave.
F. Dickinson.....38 Bryant Ave.
A. H. Gehle.....5458 Monroe Ave.
W. E. Ingersoll.....4203 Berkeley Ave.
C. H. Sewall.....3958 Langley Ave.
R. C. Thomas.....4223 St. Lawrence Ave.
F. E. Bunbury.....3758 Rhodes Ave.
R. S. Huey.....28 Woodlawn Park.
L. O. Byrne.....

BURNSIDE CLASS (Chicago).

C. M. Perkins.....Burnside.
F. Deegan.....Burnside.
A. F. Nelson.....Burnside.
C. H. McGann.....Burnside.

LAKE VIEW CLASS (Chicago).

T. S. Ellithorp.....227 Sunnyside Ave.
G. S. Rice.....652 Otto St.

BELVIDERE CLASS (Belvidere, Ill.)

R. H. Herbert.....Belvidere, Ill.

EVANSTON CLASS (Evanston, Ill.)

C. Cassard.....Evanston.
E. O. Reeder.....Evanston.
W. L. Webb.....Evanston.
F. S. Anderson.....Evanston.
E. W. Clark.....Evanston.

ST. PAUL (St. Paul, Minn.)

J. Henry Fitz.....43 Union Block.
J. W. Shugard.....373 Grove St.
H. S. Johnson.....911 Pioneer Press Building.
Thos. A. Lacy.....Care Edison Electric Co.
A. H. Hall.....240 Arundel St.
Edward A. Patrick.....108 Endicott Arcade.
W. R. Bonham.....90 Tilton St.
Fred. H. Eddy.....412 Manhattan Building.
Joseph Fewdonill.....219 Indiana Ave.
George J. Burns.....150 Dale St.

The following of the above named students having received an average per centage of 90 or over, will be entitled to apply for the second examination for scholarship:

C. Cassard.....per centage, 96.2
A. Fontaigne.....per centage, 92.5
J. W. Luce.....per centage, 91.5
F. Dickinson.....per centage, 91.5
A. H. Gehle.....per centage, 91.5
F. M. Pebbles.....per centage, 90.5
Archie T. Wheeler.....per centage, 90

This examination will take place at the office rooms of the school within the next few days. The gentlemen will be notified of the precise time.

The papers of all classes that have held their examinations will have been marked before the next issue of THE ELECTRICAL JOURNAL, and the full list will be given, also the completed plans for the laboratory course, scholarships, etc.

A total graduation of thirty-one students out of more than 500 is not a good showing in point of numbers, but it will demonstrate to those who contemplate going into the work that something more is necessary than that they shall pay the tuition fees and attend the class.

THE DENVER ENGINEERS.

Many members of the Denver class of the National School of Electricity belong to the National Association of Stationary Engineers. They had been planning to attend the St. Paul convention in force, indeed, had most of their arrangements made, when the disastrous hotel explosion occurred that killed so many people. Denver has no law regulating the registration of steam engineers, and has no provisions to insure against such accidents as the one referred to.

Immediately after the explosion the engineers got together and, with an unselfishness not often found, determined to contribute the money they had set aside for the convention in an effort to get a law passed to prevent, in the future, the results of engineering incompetence in the handling of machinery.

The absence of the Denver delegates and members will be a loss to the convention, but those at St. Paul will have occasion to feel proud that their brothers have enlisted in so worthy a cause. If the National Association of Stationary Engineers is made up, all through, of men like that, it need not be wondered at that the Association has strength in the councils of labor.

A USE FOR STATIC ELECTRICITY.

Malvern W. Iles, superintendent of the Globe Smelter at Denver, and who also is a member of the Denver class of the National School of Electricity, has contributed to the Columbia School of Mines *Quarterly* an article on the desirability of some cheap method for the generation of static electricity to condense the fumes from volatile metals. He points out that the invention of a cheap method for the generation of static electricity will enable metallurgists to save a very large amount annually in the reduction of all the well-known volatile metals, and considers the matter one which will repay the attention of electricians.

APPROVES THE WORK.

DETROIT, MICH., July 21, 1895.

To any member of the N. A. S. E. who contemplates, or is in doubt about taking the course in electricity, as laid down by the National School of Electricity, of Chicago, I will say that I have just completed the course in a class formed here, and can safely say that the course is complete and easy to understand, and if a member will give it his attention, he will be well paid for his time and money. Fraternally,

EDWARD P. GILROY,
Past Chairman Committee on Education,
Detroit Association Stationary Engineers,
No. 1, of Michigan.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

The telephone has extended its field of usefulness to the Lew-Chew islands, off the coast of Japan.

Davenport, Iowa, is drafting some ordinances with a view to regulating the operations of electrical companies in that city, and proposes to enforce them when adopted. As this will require money to carry out, a proposition is made to tax the telegraph, telephone, and electric light poles, of which there are about 5,000, fifty cents each per annum.

Installing a telephone by trotting cavalry was recently successfully performed by Prussian soldiers between Berlin and Potsdam. Two sets of officers proceeded respectively from the two points, each party being equipped with a telephone apparatus, besides the necessary amount of thin wire. The wire was connected with each town's telephone station, and, by means of a fork fixed at the end of the lance, was thrown over the tree-tops along the road. As each kilometre of wire was thus suspended, a halt was made, and it was ascertained whether there was connection with the station. The two sets met at Teltow. The wires were connected, and telephonic connection between Berlin and Potsdam was established. The distance is twenty miles, and the work was done in about four hours.

Light and Power.

The great Yerkes forty-inch telescope, at Lake Geneva, will be provided with a system of electric motors by which its several motions may be operated and regulated. The driving clock will be wound automatically, also, by an electric motor, while, in keeping with these electrical devices, the elevating floor of the observing room—about seventy feet in diameter—will be made movable by means of hydraulic rams. The astronomical observatory of the future will resemble a great machine and dynamo shop.

In Springfield, Ill., the citizens wanted to start a municipal lighting plant, but the condition of the city finances would not permit the necessary investment. It began to look as though the project would fall through, when sixty citizens came forward and advanced the necessary funds, and an arrangement has been effected whereby the difference between the cost of producing the light and the price at which it has been previously sold shall be set apart to create a fund which, it is expected at the end of five years, will reimburse the money advanced by the citizens, and place the plant under municipal ownership.

Charles T. Yerkes, who recently became a factor in the American Siemens-Halske Company, is a firm believer in the possibilities of electricity. The trolley, he says, is a very good means of conducting current for car purposes in the absence of something better, but he does not regard it as the apogee of electric motor power. Not only will electricity supplant steam in time, he says, but it will be used generally some day for heating houses, for cooking, and for a dozen purposes now not even suggested. He predicts that the next five years will bring a final solution of the problem of electric transportation.

Railways.

Trolley parties are becoming quite the fad in Chicago.

An electric railway is projected between Detroit and Port Huron. The distance is sixty-five miles, and it is said that the line, power stations and equipment can be furnished for $500,000.

It has been rumored, but denied on the part of the General Electric Company, that they were seeking an alliance with some locomotive works, similar to that of the recent Westinghouse-Baldwin combination.

The Massachusetts railway commissioners have made a rule calling for the heating, by electricity, of the street cars of that state, in operation during the winter months. The temperature must be maintained between 50 and 60 degrees above zero, excepting when prevented by some accident or emergency.

Arrangements are being made for a chain system of electric railways, which shall take in towns in Pennsylvania, Ohio and West Virginia, within a radius of some 200 miles from Pittsburg. The Second Avenue Traction Company, of Pittsburg, will undertake the work, the funds being supplied by a syndicate of Baltimore capitalists in conjunction with the traction company.

A representative of the New South Wales government has been traveling in Europe and this country, giving special attention to the development of electricity as applied to railways. He says the government of Australia has built and owns almost all the railroads, and that there is an inclination to adopt electricity for motive power and for automatic signaling and switching.

Jay Gould is said to have expressed himself, ten years ago, to the effect that steam could not much longer be the chief motive power of the world, and he was then looking forward to experimenting with electric motors on his elevated system in New York. Mr. Gould did not live to carry out these experiments, but he saw far enough into the future to know that electricity was the coming power.

The Brooklyn Eagle calls attention to the fact that notwithstanding the great hue and cry about deaths due to trolley car accidents, the death rate, in proportion to the number of passengers carried, is very much less in street railway traffic than on the lines of steam road. Taking three leading lines of railway the average rate is one death to every 82,000 persons carried, while in Brooklyn the figures, as applied to the street railway, are one in every 3,135,000.

At the present time omnibuses and a few horse cars constitute the principal means of travel in the streets of Rome. A concession has, however, just been granted to the Societa Romana degli Omnibus for the building of an electric road to run from the general postoffice to the principal railroad station in that city. Grades of considerable size will have to be overcome. The overhead Thomson-Houston trolley system will be adopted, and it is expected to have the line open for business on September 17 of this year.

Mr. Pugh, one of the vice-presidents of the Pennsylvania Railway Company, has expressed himself regarding the use of electricity on trunk lines as follows: "I do not believe, from my own knowledge, that electricity will ever take the place of steam in locomotives, because I do not believe it can be done with reasonable economy. I think the development of steam has solved the question of rapid transportation as far as the traveling public want it settled. I do not believe that either you or I want to travel at the rate of 90 miles an hour, and I do not think the majority of people are anxious to."

General News.

The production of copper in the United States is more than two-thirds of that of all other countries combined.

A bureau of electric wiring has been established in Pittsburg. Its work will be to inspect all wires, to see that they are properly put up and insulated, so that there will be neither danger of fires nor peril to human life.

Charles T. Yerkes, the Chicago street car magnate, is an enthusiastic wheelman. He began to ride first about four months ago. He gets up at five o'clock in the morning and spins from ten to fourteen miles before breakfast.

De Laval, the distinguished Swedish electrician and inventor, has discovered a process of melting iron ore by electricity by which means it is expected that steel plate for ships and for various other uses can be produced at one-fourth of the present cost.

The annual convention of the National Association of Electrical Workers will be held in Washington, November 11 to 17. It has been decided to have a parade in connection with it, on one evening. It is expected that a number of the largest electrical manufacturers in the country will lend their aid.

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REUNION OF TELEGRAPHERS.

Fifteenth Annual Meeting of U. S. Military Telegraph Corps and Old Time Telegraphers Association.

On September 11, 12 and 13 the fifteenth annual reunion of the United States Military Telegraph Corps and the Old Time Telegraphers and Historical Association will be held in New York city. The event is one which is being looked forward to by the Knights of the Key, and promises to be the best attended and most successful of their annual gatherings. The members of the two societies will be the guests of the electrical fraternity of New York city and vicinity, which is tantamount to saying that their entertainment is in good hands. The program of the meeting will be:

PROGRAM.

Sept. 11.—10 A. M.—Business meeting of Old Time Telegraphers and Historical Association.

2 P. M.—Business meeting United States Military Telegraph Corps.

W. R. PLUM,
President United States Military Telegraph Corps.

8 P.M.—Entertainment especially arranged for the occasion at Chickering Hall, 5th avenue and 18th street.

J. E. PETTIT,
Secretary United States Military Telegraph Corps.

Sept. 12.—10 A. M.—Ocean excursion to Long Branch, the famous summer resort of the New Jersey coast.

2 P. M.—Banquet at Long Branch, N. J.

Sept. 13.—General sight seeing. "Go as you please."

The several committees in charge of the arrangements have been directing their efforts with a view to making this meeting one of the best of the annual reunions. Temporary headquarters of the associations are at the Broadway Central, New York.

ELECTRICITY IN THE NURSERY.

The newest electric household appliance—and in future no nursery will be complete without it—is "the baby alarm." It often happens that in a large house, where the infant is sleeping in a room on an upper story, the nurse cannot retire to the servants' room, which may be on a different floor and too far distance for any one to hear the child's signal that it is awake. The intention of the baby alarm, says the New York *Times*, is to give warning to any required distance when the child cries. A sensitive microphone, placed near the cot, is connected to a battery and an induction coil, and thence by wires to a small electro-magnet at the end where the sound is to be received.

When the child cries the microphone will set up an undulatory circuit, the electro-magnet will be actuated, its oscillation will close a bell circuit, and a bell will continue to ring as long as the sound of the baby's voice is sustained. As the device is at present constructed the adjustment of the balance-lever, which is set in motion by the electro-magnet, is so delicate that the apparatus has to be handled with extreme care, and any bungling by inexperienced persons is apt to derange it. Suggestions have been made for lessening the complexity of the instrument and making of it a practical and durable means of enabling infants to unconsciously signal to a distance, and thus save much anxious watching on the part of those in charge.

TROLLEY CARS FOR FUNERALS.

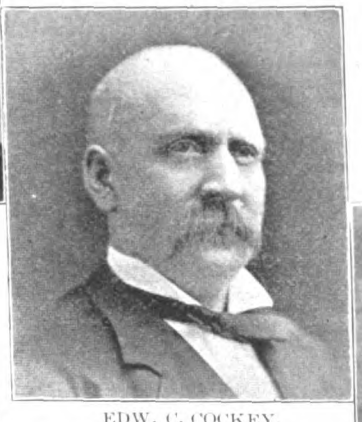
Managers of electric street railways are preparing for the casket, pall-bearers, minister, mourners and friends. Funerals by electric car to the far away cemeteries, they believe, is the next step in surface transportation.

This follows closely the innovation of the postal-car attachment to the cable train. It is intended to furnish a cheap means of reaching the various cemeteries with as little discomfort as possible. The result is that somber-colored cars, with mourning drapings, will be made and put in Chicago streets on order within a few months.

From present indications the West Chicago company will be the first to include funeral trains in its service. The scheme has been under discussion to the extent of formulating a general plan of introducing and handling the new service, but the details have not been adopted.

To introduce the service two cars will be constructed especially for the purpose to which they are to be put. In interior fittings and finishings they will differ materially from the ordinary car. They will be painted black on the outside and bear other indications of their character. Funeral parties may charter the train and start from any point on the line of the road. Arrangements will be made to transfer the train to the Cicero & Proviso tracks, which run direct to Forest Home, Waldheim and Concordia cemeteries.

Assistant General Manager Yuille said yesterday that the company contemplated adding a funeral train to its service, but the plan would not be put in operation before next spring. Other cities, he said, were operating successfully such a service, and he saw no reason why it should not be introduced in Chicago. He believed a large number of people would be benefited thereby. Especially is this true,



EDW. C. COCKEY,
President Old Time Telegraphers and Historical Association.

WM. J. DEALY,
Secretary Old Time Telegraphers and Historical Association.

where burials are made at cemeteries not easily reached by railroads. This service, he said, also has a very material advantage over accommodations furnished by railroad lines in being at the disposal of patrons at any time *Chicago Record.*

AN ELECTRIC PHENOMENON.

The records of lightning storms the past summer furnish some strange doings of the elements, such as demolishing churches, tearing off clothes, melting down hairpins, singeing the hair and making holes in shoe leather. But it has done nothing stranger anywhere than in New Brunswick, N. J., where the electric fluid ran down the point of an umbrella and so paralyzed the arm of a young man that it remained clasped around the waist of a young lady he was walking with, and she was extricated with the greatest difficulty. It was also noticeable that the same stroke seemed to have affected her will power, and she was incapable of rendering any assistance to those who were trying to rescue her from the young man's fierce and unconscious embrace. Hereafter, when a stray arm is seen around a girl's waist during a thunder storm, it can be explained as a purely electrical phenomenon.—*Albany Press.*

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SACRAMENTO WILL CELEBRATE.

Carnival in Honor of the Successful Transmission of Electric Power from a Distance—Native Sons of the Golden West will Participate.

ELABORATE ILLUMINATION AND PARADE.

The 9th of September will be a memorable day in the city of Sacramento, the capital of the state of California, for on the night of that day the citizens will hold a carnival in honor of the successful transmission of electric power from the foot-hills of the Sierra Nevada, 22 miles distant, sufficient to turn all the wheels of industry in the busy little city of the plains. The great dam on the American river that furnishes the immense water-power, which has made this event possible, was completed two years ago, but it was only recently that the canal was constructed that conducts the water to the power-house a half-mile further down the river. The first of the four great generators that are to supply eight thousand horse-power of electric current to Sacramento, a few weeks hence, was placed in position last month, and at daylight on the 12th of July, amid the booming of cannon, the current was turned on and instantly the ponderous machinery in the power-house in the city began to move. Everything worked to a charm, and now, for more than a month, Sacramento City has been receiving one thousand horse-power of electricity, more than sufficient to operate the street car system of that city, which is a part of the property owned and operated by the Sacramento Electric Light and Power company. Contracts have been closed with manufacturing firms, newspaper offices, mill owners and individuals for electric power and lights, and in a few weeks the other generators will be in operation to meet the demand. It is to celebrate the successful accomplishment of this great enterprise that the people of Sacramento are to hold a grand electric carnival on the 9th of September.

Committees have been at work for some weeks in arranging the details, and assurances have been received that the demonstration will be carried out on a grand scale. The carnival is to take place on the night of the 9th, because on that day all the organizations of the order known as the Native Sons of the Golden West will be in Sacramento to celebrate the anniversary of the admission of California into the Union. This event is celebrated annually in the different cities of the state. Every town has its "Parlor," while the larger cities have several, each with thousands of members. The Native Sons of Sacramento are erecting beautiful arches on the chief streets, and the buildings are to be decorated with emblems typical of pioneer days. The arches will be illuminated at night as a part of the electric carnival display. The State Fair will be in progress at Sacramento at that time, and the city will be thronged with visitors from all parts of of the state, most of whom, however, are going there to witness the beautiful electrical display. Advices from Sacramento state that the city is already brilliant with the display of the carnival colors, apple-green, cherry-red and poppy-golden. The windows of the stores gleam with them; green, gold and red ribbons flutter from carriage and buggy whips, from the handle-bars of all the bicycles, and from lapels of men's coats, while the ladies manage to work in delicate bits of the coloring somewhere in their hat trimmings or about their gowns. Mayor B. U. Steinman, although president of the corporation that now furnishes the city with electric lights, has taken an active interest in promoting the electrical carnival, for its significance is more than local. It signalizes an event that is full of importance to the whole scientific world, for the fact has been fully demonstrated that electric power is capable of being transmitted a long distance

SACRAMENTO CARNIVAL ILLUMINATIONS.

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at a comparitively small loss in transit. Engineer F. O. Blackwell, representing the General Electric Company, and who was sent to Sacramento to set the plant in motion, states that the loss in transmission over the 23 miles from the dam to the city does not exceed ten per cent, and is probably much less. Encouraged by the success of the Sacramento enterprise, other and similar ones have already been projected in California, and ere many years electric wires will be running from the canyons of the Sierra Nevada, all along the line of the great Sacramento valley, hundreds of miles in extent, out into the cities and towns, giving motor power to factories, lighting streets and dwellings, and even operating much of the machinery used on farms and in orchards for irrigating and other purposes.

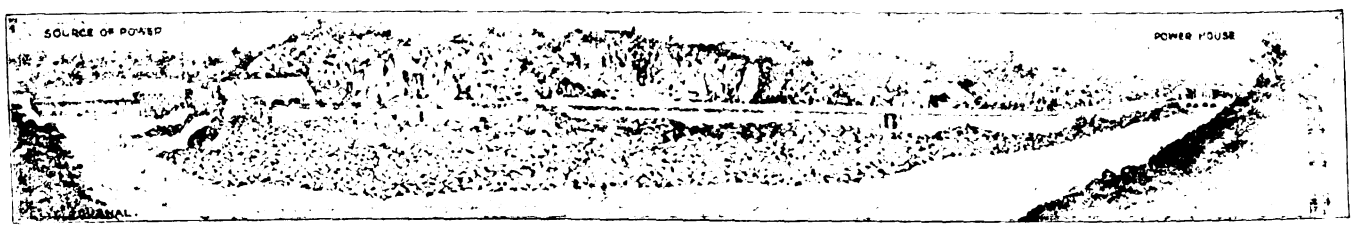
The carnival display at Sacramento will embrace many beautiful as well as practical features. The stately capitol building, rising from a series of terraces in the center of a park of about fifteen acres, in the very heart of the city, will be illuminated, both inside and outside, from the very apex of the golden dome, 300 feet high, to the ground. Festoons of incandescent lights will fall gracefully from the dome to the tops of the pine and cedar trees surrounding the buildings, while all the grounds will be illuminated. Many beautiful designs will also be distributed about the city. There will be an illuminated arch at the foot of K street, bearing the word "Welcome." At Tenth and K streets another arch has been erected to represent "Progress." On Second street, through which visitors entering the city by rail must pass from the depot, "New Sacramento" will blazon forth from side to side. At Fourth and J streets will be an immense horseshoe reaching across the street and supported from the roofs of four story buildings. It will be illuminated in all the colors of the rainbow.

On the city plaza there will be several other designs typical of industry and progress, as well as some of a purely fanciful character. The parade promises to be the most gorgeous thing of the kind ever witnessed. Not that it will be on a grander scale than demonstrations that have taken place in the larger cities east of the Rocky mountains, but it will be the pioneer in the way of a purely electrical display, and in this respect Sacramento will enjoy a distinction of which many larger and more pretensious cities might well be proud. While there will be many ornamental features in the parade, those of an industrial character predominate. In the railroad shops alone there are upward of two thousand mechanics employed in the various departments, and twelve of the more important branches will each have a float in the line, drawn by its own men. Even the ropes attached to the floats will be illuminated by incandescent lights. The employes of each department will wear a uniform distinct from those of the other departments. In addition to these floats, which the workmen themselves will construct, the general committee has provided five others. These will be moved by electric power over the street car lines, and will be very elaborate. The first will be a representation of an American flag, and will be fashioned of electric lights of appropriate colors. In the foreground will be an American eagle surmounting a shield. This float will also be typical of scenes in the early settlement of California by the whites, prominent among which will be a representtation of the old "bear flag," that was raised at Sonoma by a handful of Americans about the time that Fremont was fighting the Mexicans about Monterey. Surrounding the bear flag will be piles of cannon balls, sentinels on guard and kindred features.

The second float will represent "California." There will be two figures, one indicative of the State, and the other of Sacramento, with a number of other figures as attendants. It is promised that this float will be a fine piece of decorative art.

Float No. 3 will represent "Fruits and Flowers." Beneath an illuminated canopy of variegated colors will be seen the figures of "Pomona" and "Flora," surrounded by dazzling beautiful fruit and flower designs. In the foreground will be an immense vase of brilliant illuminated golden poppies (the State flower), groups of electric boquets, wreathes, etc., all in colored lights of the proper shade. Above the two principal figures will be suspended illuminated wreathes, and each figure will have attendants.

Float No. 4 will typify the "Native Sons of the Golden West." They are to attend to its decorations, which will represent emblems of that order and other features of pioneer days. All the flag-staffs, telegraph, electric light and telephone poles on the business streets will be entwined with the carnival colors. The large 200 foot flag staff on the city plaza will be a shaft of living light, of various colors artistically blended. Upward of 12,000 yards of carnival bunting will be required to decorate the poles. The illumination of the state capitol buildings will require about 3,000 lights. The pinnacle of the dome will be surmounted by a search-light of such great power that it will be visible for many miles about the surrounding country. Its rays will be turned, at intervals, upon the towns of Woodland, Folsom and other places within a radius of twenty miles. In addition to these displays and illuminations, nearly every building on the business streets and many private residences will be decorated with the carnival colors in such designs as their owners may see fit to adopt, and most of them will be illuminated. The carnival will be a revelation to the old Californians of the interior of the state who have not kept in touch with the marvelous progress of the age in the development of electrical science and motive energy. For the matter of that, it would be a revelation none the less to the people of many other states of the Union. Sacramentans are naturally proud of the distinction of being the first in all the world to prove the fact, which many engineers and scientific men had disputed, that electric energy can be transmitted over long distances at a trifling percentage of loss.



FOLSOM-SACRAMENTO POWER PLANT.

ELECTRIC FISH.

A French scientist, it is said, has managed to measure the electric current of a torpedo fish, and finds that it is from two to ten amperes, and with a difference of potential of from fifteen to twenty volts. It is, of course, not continuous, and nothing is said about how long a time is required to store up the energy for such a discharge. The maximum current thus indicated represents about a fourth of a horse power an enormous output, considering the size and weight of the apparatus. D'Arsonval is of the opinion that the torpedoes have a special muscle which gives electrical instead of mechanical energy, but as this is only a guess, it can hardly be termed "another instance of the equivalence of all forms of energy."

Entries are being received by the Chicago Times-Herald in sufficient numbers to insure a lively competition in the horseless carriage contest, which takes place November 2. The route originally planned has been changed somewhat, and instead of starting in Milwaukee and ending in Chicago, both the start and finish will be in Chicago, Waukegan being the point at which the turn will be made.

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ANDRÉ-MARIE AMPERE.

French physicist. Born at Lyons, 1775. Died, Marseilles, 1836. Founder of the science of Electro-Magnetism, or as he called it "Electro-Dynamics." His name was given to the Unit of Current because of his discoveries.

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The Electrical Journal.

Vol. 1. CHICAGO, SEPTEMBER 15, 1895. No. 8

MEASUREMENTS OF RESISTANCE.

Voltmeter Method where there is a Ground on one or Both Sides with Formula for Determining Results in their Respective Cases.

APPLICABLE WITH PLANT IN OPERATION.

The measurement of the insulation resistance of electric lighting and other circuits, by means of a resistance set and battery, gives correct results, but is often inconvenient of application, and is always open to the objection that it cannot be used when the plant is in operation. The use of the voltmeter as an indicator of "grounds" on the circuit is well known, but it is not so well known how to compute the insulation resistance from the voltmeter indications, especially when a ground exists on both sides of the circuit.

When there is a ground on one side of the circuit only, the fact is indicated by the voltmeter showing no deflection when connected to that side, but giving a greater or less deflection when connected to the other side.

In Fig. 1, D is the dynamo of, say a 110-volt electric lighting circuit, P and N are the circuit wires, and G is a ground, such as a system of water or gas pipes X is a connection of greater or less resistance between P and the ground. Connect the voltmeter A between N and G, and there is then a complete connection between P and N, through X and A. Let the potential difference between P and N be represented by V, the potential difference between N and G, as shown by the voltmeter, by v, the resistance of the

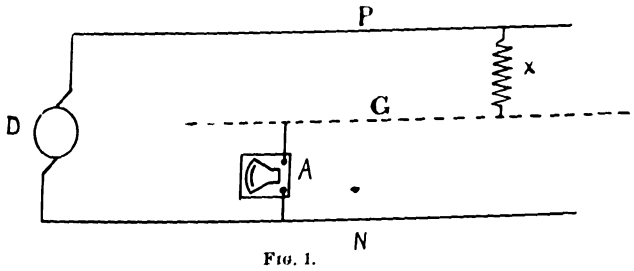

Fig. 1.

voltmeter by r, and the resistance of the ground connection by x.

It is evident that the current flowing through the voltmeter is $\frac{v}{r}$, and that the current flowing through x is $\frac{V-v}{x}$, but the same current flows through x that flows through A: hence

$$\frac{v}{r} = \frac{V-v}{x}$$

$$\text{and } x = \frac{V\,v}{v}\,r \quad (1)$$

This formula is pretty well known and is often used for the determination of insulation resistance. It gives a fairly correct result, even when grounds exist on both sides of the circuit, if the insulation resistances are high. But if insulation resistances are high, it is of little consequence to know their value When the resistances are low, a few thousand ohms only, formula (1) may give results greatly in error if used for cases where grounds exist on both sides of the circuit. Although the correct formula for this case has been published, it seems to be little known, and I give the investigation here in a somewhat simplified form.

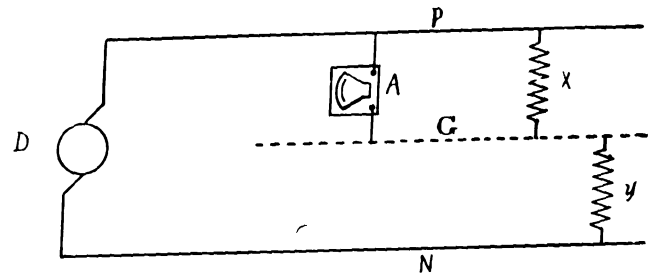

Fig. 2.

Fig. 2 represents a circuit having ground connections of unknown resistances on both sides. Let the voltmeter be connected between P and G, as shown, and let its reading be v'. This is the potential difference between P and G *when the voltmeter is connected*, and it must be noted that connecting the voltmeter alters the potential of P. At the same time $V-v'$ is the potential difference between G and N.

Let r, the resistance of the voltmeter, and x and y, the resistances of the connections of P and N respectively to ground, we have, since v' is the potential difference between P and G, the current through A equal to $\frac{v}{r}$, and through x equal to $\frac{v'}{x}$ also through y the current is $\frac{V-v'}{y}$. But the sum of the currents through A and x is equal to the current through y; hence

$$\frac{v'}{r} + \frac{v'}{x} = \frac{V-v'}{y} \quad (2)$$

If now the voltmeter be connected between G and N, we shall have a deflection v', and the same reasoning will give the following equation:

$$\frac{v}{r} + \frac{v}{y} = \frac{V-v}{x} \quad (3)$$

From these two equations the values of x and y may be determined. They are:

$$x = V - \frac{(v+v')}{v}\,r \quad (4)$$

$$\text{and } y = V - \frac{(v+v')}{v'}\,r \quad (5)$$

If now v' be 0, the value of y becomes infinite and x becomes

$$\frac{V-v}{v}\,r \text{ as in (1)}$$

As an example: Suppose that on a circuit of 110 volts the voltmeter shows, when connected from P to ground, 4 volts, from N to ground, 6 volts; the resistance of the voltmeter being 16,000 ohms, the insulation resistance of P is then

$$\frac{110-10}{6} \times 16{,}000 = 266{,}667 \text{ ohms}$$

$$\text{and of N is } \frac{110-10}{4} \times 16{,}000 = 400{,}000 \text{ ohms.}$$

The error from using formula (1) in this case would be small. The latter value would become 424,000 ohms, in place of 400,000

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But assume that the reading from P to ground was 10, and from N to ground 40, the insulation of P is then

$$\frac{110 - 50}{45} \times 16{,}000 = 24{,}000$$

And of N is

$$\frac{110 - 50}{10} \times 16{,}000 = 96{,}000$$

Using formula (1) the insulation of N would be

$$\frac{110 - 10}{10} \times 16{,}000 = 160{,}000$$

which is much too large.

Wm. A. Anthony.

CLAIM AN INFRINGEMENT.

Suit by Siemens-Halske Company Against Metropolitan "L" for Using Third Rail System.

An important lawsuit has been entered in the United States Circuit Court at Chicago, which involves the rights to the third rail system of operating electric railroads. The complainant in the case is the Siemens-Halske Electric Company, and the action is directed against the Metropolitan Elevated Railway, which is using the third-rail system on its line in Chicago. This is the system which was so successfully operated during the World's Fair, a line being in operation upon the Exposition grounds.

The Siemens-Halske Company claim prior right to the invention under patent No. 324,176, issued to Dr. Werner Siemens, of Berlin, under date of August 9, 1885. On the other hand, Mr. W. E. Baker, who is at present the electrician of the Metropolitan road, claims to be the originator of the idea, and to be secured by patent right. It was Mr. Baker who made a practical application of the principle to the Intramural line at the Exposition. It is claimed on behalf of the Siemens company that early in the present year, before the Metropolitan commenced operations, that they served notice on the railroad company, claiming an infringement. The railroad company in turn, it is said, notified the General Electric Company of the threatened action, but the work was carried to completion notwithstanding. Now the plaintiff in the case asks for a restraining order, and Judge Showalter will pass upon that phase of the case at an early date.

It is of interest to note in this connection that Charles T. Yerkes, who is heavily interested in the Siemens-Halske Company, since its recent reorganization, is also the principal owner of the street car lines with which the Metropolitan Elevated is a direct and somewhat formidable competitor. If the Siemens company succeed in establishing their claim, Mr. Yerkes will have killed two birds with one stone; first protecting his interests in the Siemens company, and second, in paralyzing, to some extent a strong competitor in the transportation service.

The system in use in the tunnel of the Baltimore & Ohio road has been attacked by the Siemens & Halske company. The contact used is a sliding one, and includes principles claimed by Dr. Von Siemens' patent.

GIVE THE DEVIL HIS DUE.

The Chicago Evening Journal, conspicuous for its old fogyism and its blind and unreasonable antagonism to trolley lines, has finally been prompted to admit that there are after all one or two redeeming features about the service. It must have been with some reluctance that the admission was made, but if the devil is entitled to his due in one case, he is equally entitled to it in the other. The Journal's editorial says:

"On the principal of giving the devil his due, it must be admitted that the all-pervading trolley line is a great educator. It is doing locally what the railroad is doing nationally and internationally. But, further than this, it is making a vast change for the better in the men who run the street cars.

"It requires a higher grade of intelligence to run a trolley car than to drive a mule. Under the trolley regime drink has been prohibited for the same reason that it is prohibited among railway engineers, and for a similar reason the motormen, as a rule, are intelligent and respectable.

TIME MEASURING INSTRUMENTS.

Much interest has been aroused in the scientific circles of Europe by what is claimed to be the most wonderful timing instrument in the world, the pendulum-chronoscope, invented in this country by Professor C. B. Bliss, and perfected in the psychological laboratory of Yale by J. J. Hogan. It can be used with the quickness of a stop-watch, without the help of either electrician or mathematician. It measures accurately down to the one-thousandth part of a second and is already taking the place of the old style chronoscopes in scientific laboratories. The instrument is an ingenious combination of mechanical and electrical attachments. It tells the speed of a cannon ball, the lapse of time between the firing of a pistol and the starting of a runner, and it is proposed to introduce it into boxing schools, so that pupils can constantly test the speed with which they can deliver a blow, and so note the lessening of the reaction time between the brain impulse and the blow on which increase of skill depends. The machine consists of a pendulum and a pointer swinging independently on the same axle. The tip of the pointer travels along the face of a curved scale or indicator, which is graduated to show the one-thousandth of a second. To measure the time required for the transmission of any given impression a button is pressed. This sets the pendulum in motion and the result is registered on the scale. If a sight test is to be made, when the pendulum comes in contact with the pointer a black shutter is raised from a light disk. As the disk flashes on the sight of the subject, he touches a button and the pointer is instantly stopped. The average time between the exposure of the disk to the sight and the pressure of the button has been found to be 0.300 of a second. The reflex action for sound is quicker than this, being put at 0.130 of a second. The discerning of colors is looked upon as an important test in the determination of certain traits of the pupil. A square of some color unknown to the subject is to be exhibited from behind a shutter. He is told, for instance, to press the button when he sees blue. This test sometimes extends to one-quarter of a second. The trials with odors, noises and pin pricks are very interesting. The object of these tests in school work is to enable teachers to ascertain the mental characteristics of their scholars. Under the old system of teaching all the scholars in a class were grouped together and subjected to the same inflexible rule of tuition, regardless of their differences of temperament and intellectual ability. The chronoscope puts an end to such crude methods and reduces teaching to a science.

WHO OWNS THE ROAD.

The General Railroad Company of Chicago thinks it is a poor rule that will not work both ways, and its management proposes testing whether a one sided rule can be applied to its detriment. The General Railway, some time ago, built a line on twenty-second street and undertook to use in connection with it a short piece of road belonging to the Chicago City Railway Company. The little formality of asking permission was overlooked, and as a result one of the cars of the General company was made kindling wood of by the employes of the Chicago City Railway Company. Then a lawsuit followed, in which it was contended on the part of the General company, that the streets and tracks were public property, and that they had a perfect right to use the rails of companies already in operation, but the learned judge did not see it in that light and held that the tracks were private property, and could not be used by others than the owners without giving proper compensation. It is to test the validity and the applicability of this ruling that the General Railroad company has instituted proceedings against the John Spry Lumber Company, charging them with damage at the rate of twenty-five cents per load on 4,000 loads of lumber, which have been carted over their tracks. Judge Tuley will now be required. President Bonney of the General Railroad Company says, to show whether by any method of judicial juggling he can make fish of one and flesh of another.

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DIRECT CURRENT TRANSFORMERS.

Growing Use of Motor-Dynamos—Method of Obtaining Their Efficiency Principles of Testing.

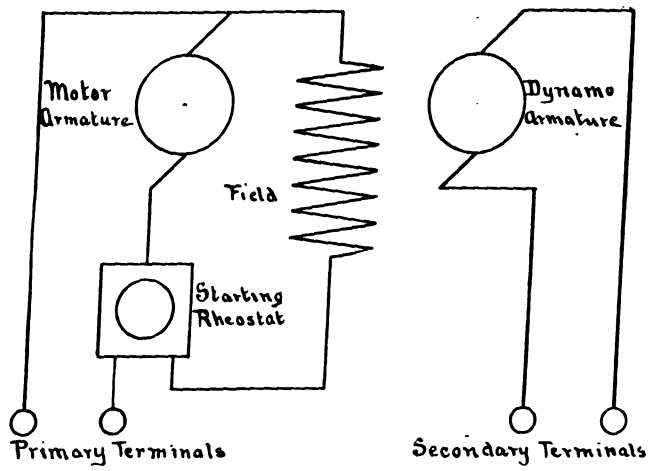
Continuous-current transformers, or, as they are more commonly called, "Motor-Dynamos," form an extremely interesting class of commercial electrical machinery, on account not only of their rapidly increasing use in very many of the electrical arts for certain special purposes for which they are remarkably well adapted, but also from the scientific point of view of the electrical engineer seeking after new and improved methods of current supply. The term "Dynamotor," which has sometimes been applied to these machines, is to be tabooed, as being too much of a verbal freak produced by the modern tendency to over-conciseness and abbreviation. "Motor-dynamos," then will be described for the benefit of readers of THE ELECTRICAL JOURNAL, the necessarily brief and elementary description being followed by an account of an actual test on one of these machines of a well-known make. It is hoped that a careful and intelligent perusal of the record of this test will enable every reader to grasp the really simple principles of dynamo testing involved. The method of computing the combined efficiency of the motor-dynamo, as to be presented, should serve the beginner who is really interested in this vast and highly important subject. It will be noted that the method depends on electrical observations only, using voltmeter and ammeter, thus serving to introduce to the student of the subject the various other purely electrical methods of determining the efficiency of dynamo-electric machinery.

The object of a motor-dynamo is to transform a direct, or continuous current from one "voltage" to another. For example, in a large electro-plating establishment, the work requires the use of a large amount of current at a comparatively low electro-motive force. Nowadays, the use of primary batteries for any but very small amounts of plating is not to be considered. The current supply for such a purpose must either be obtained direct from a dynamo which is driven by a steam or gas engine, for example, or from the lighting and power mains to be found now in every city. But the former method necessitates the installation of an engine, with the requisite belting, shafting, etc., and needs also the services of an engineer to keep the plant in order. The latter method, *i. e.*, taking current from the lighting mains directly, is out of the question, on account of the very great waste of (electrical) power in the dead resistance which has to be used to cut down the voltage to the amount required for electro-plating work. In the case referred to, the loss from C^2R effect in the resistance coils would be far greater than the electrical power usefully expended in doing chemical work in the plating vats. But the same thing would hold good in a variably less degree for charging storage batteries, for example, so that such a way of obtaining current at the proper electro-motive force for the work in hand is quite out of the question from the great waste of power which is involved.

Of course, in a factory wired for electric light, an electric motor can be installed which can be belted directly to a special dynamo adapted for the work in hand. But the motor-dynamo is an improvement even on this arrangement, by combining motor to dynamo in one machine. Then all belting is done away with, the floor space occupied (frequently an important point) is no more than that required for a single machine, no particularly good foundation is required, and last, the combined efficiency is greater than the next best arrangement—motor belted to dynamo. Of course, as a single machine, the minimum of attendance is required—a little attention now and then, from some workman regularly otherwise employed, is sufficient to keep it in good running order.

In general appearance, these machines resemble an ordinary motor or dynamo, except that there are two commutators, one at each end of the armature, connected respectively with each of the two armature windings. The windings are wound together on the same core, forming a composite armature which rotates in a common magnetic field. There is no pulley on the shaft; none is needed, since the driving power enters by the two wires connected to the brushes bearing on the motor commutator. The field of the machine is commonly a shunt winding, bridged across the motor terminals, and the motor armature circuit contains a regular rheostat, or "starting box," for bringing the machine up to speed gradually in the usual way. The brushes bearing on the dynamo armature's commutator are connected directly to what might be called the secondary terminals of the machine, from which is delivered current at the electro-motive force desired, for which the winding is designed. In many machines carbon brushes are used on the motor side, and copper (woven wire or strip) on the dynamo side, as most of the machines in use are designed as "step-down" transformers; *i. e.*, to take current at 110 volts, 220 volts, or 500 volts on the primary side, delivering a much larger volume of current at a correspondingly lower electromotive force on the secondary or dynamo side. Thus, in the motor-dynamo, of which an account of a test is given below, the motor winding and the shunt field were supplied from a lighting circuit of 110 volts pressure, while the dynamo armature gave at full load 25 amperes at only 20 volts pressure.

The diagram shows the connections of this machine, which are similar in all respects to most of the transformers of this type at present in use.



It should be stated at this point, that there are a number of machines of this type in successful use by various telephone companies, in which the secondary armature winding gives an *alternating* current of proper frequency for ringing the polarized bells and operating the annunciator drops used in the telephone exchange system. Such machines are built in small sizes, and admirably replace the crude and very objectionable old "magneto" formerly in use for this purpose, with their accompaniment of shafting, belts and driving power. In this form of motor-dynamo the secondary armature is of the "open coil" type, of simple construction, and connected to a pair of collector rings as in the large alternating current generators used for lightings.

Coming now to the particular machine of this type, a test of which is to be explained, it is sufficient to state in general description of the same that it was of the bi-polar, inverted field type, with self-oiling bearings, and of generally good construction throughout. The following specification appeared on the name-plate:

1 H. P. Speed 1500. Primary, amperes 6.5, volts 110. Secondary, amperes 25.0, volts 22.0.

The machine was in use regularly for charging a storage battery of 10 cells, and it was desired to make an efficiency test upon it under its regular conditions of work. By "efficiency" in this case is meant the ratio of power taken out of the machine at its dynamo terminals to power put in at the motor terminals. Further, as both input and output are, in the case of a motor-dynamos measured in electrical units, *i. e.*, watts, we have only to divide the number of watts taken out of the machine by the watts input to obtain its actual efficiency. The efficiency to be ex-

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pected from this machine when run at its "full load," under the specified conditions, may be figured, then, from the data given on the name-plate, as quoted above. The number of amperes required to run the machine at its regular load, when the motor terminals are connected to mains having a potential difference of 110 volts, is stated to be 6.5; hence the "watts input" is the product of this current and electro-motive force, (since 1 watt = 1 ampere X 1 volt,) or 110 X 6.5 is 715. Similarly, the full load output current is stated to be 25.0 amperes, at a difference of potential at the secondary terminals of 22.0 volts. Therefore the "watts output" is 25.0 X 22.0 = 550. Therefore,

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} = \frac{550}{715} = 76.9 \text{ per cent.}$$

This per cent., it should be borne in mind, is the *joint* efficiency of the machine as a whole, that is, of the combined motor and dynamo. Further, it is a figure given by the maker of the machine as the result of a test under exact and favorable conditions, and is worked out above merely to explain what the efficiency of a motor-dynamo is, and how it is figured, when the actual input and output are known. But it is intended now to give a record of a test made on the same machine under everyday running conditions, and not only to figure the efficiency under those conditions, but also to examine into the various sources of losses of the machine, which, added together, will amount to the difference between the input and the output. It will be seen that several of these losses can be closely computed by electrical measurements, simple and easy to make; thereby enabling us to see from the test wherein the machine is defective, and what parts are capable of improvement with a view to increasing the efficiency, in the construction of a similar machine.

The instruments provided for the test were a voltmeter with a 150 volt and a 15 volt scale, an ammeter reading to 50 amperes, and a milammeter reading to 1500 milamperes, all of the well known Weston make, with a speed indicator for finding the revolutions per minute made by the armature when the machine was running under the test. The regular daily "run," charging the battery of ten storage cells, was started about an hour before the observations which were to furnish the data of the test were begun. This was to allow the machine to attain its maximum temperature for the run, as well as to give plenty of time for the charging current delivered to the battery from the secondary terminals to settle down to a nearly constant figure.

The first reading taken was the potential difference at the terminals of the motor. This was the indication of the voltmeter when connected across the double pole switch which served to connect the motor side of the machine with the "110 volt" mains from which it was run. The reading was found to be practically constant at 107.2 volts. Meanwhile, the ammeter connected in the motor circuit so that the whole current supplying the field and motor armature passed through it indicated a current which varied slightly, but averaged 7.1 amperes. These readings were put down on paper, and the two instruments transferred to the secondary, or dynamo side of the machine, in order to obtain E. M. F. and current readings on the output, 24.3 volts and 22.2 amperes, respectively. In taking the current readings, the ammeter was introduced into the circuit without opening the latter, so as not to disturb the run or vary the conditions in any way. The mean of several trials with the speed indicator showed an average armature speed of 1480 revolutions per minute. The net efficiency of the motor-dynamo could now be computed from the figures obtained as above:

Power put in at motor=107.2 volts X 7.1 amperes = 761.1 volts.

Power taken out from dynamo=24.3 volts X 22.2 amperes = 539.5 volts.

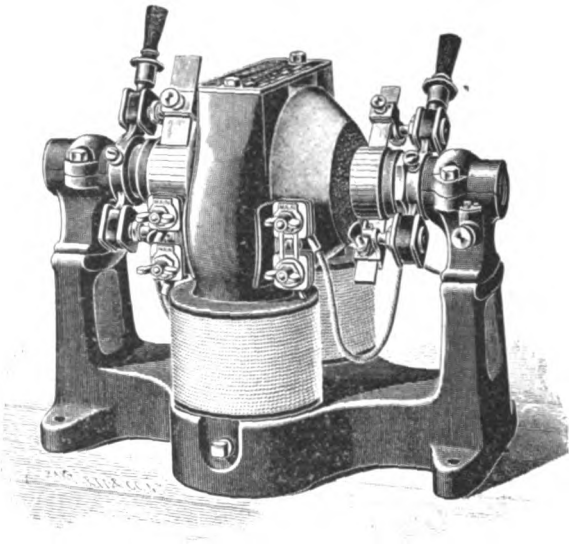
And since the efficiency of the transformer is the ratio of the output to the input, we have, for the given test:

$$\text{Efficiency} = \frac{539.5}{761.1} = 70.9 \text{ per cent.}$$

It must be remembered that this figure is the *combined efficiency* of the machine, which is a motor and dynamo in one. Hence, if the assumption is made that the two sides of the machine are equally efficient, the efficiency of each would be the *square root* of 70.9, or about 84.2 per cent.

The net efficiency of 70.9 per cent., as computed from the actual test, falls short of the 76.9 per cent. figured from the input and output specified on the name-plate of the machine because for one thing the impressed E. M. F. on the primary side was less than the 110 volts for which the machine was designed. Moreover, at the time of the test, the secondary terminals were delivering only 22.2 amperes, instead of the full 25.0 amperes which had been given out by the dynamo side before the storage battery had become as fully charged as at the time the test observations were taken. Other circumstances, such as the difference in speed from the 1500 revolutions per minute specified, and a slight change in the position of either set of brushes, would also affect the performance of the machine.

In order to locate some of the losses in the machine, which in every dynamo or motor are the cause of the "efficiency" being less than 100 per cent (i. e., output equal to the input) the motor-dynamo was stopped, or "shut down," immediately after the above efficiency test, for the purpose of measuring the resistance of the common field winding and the two armature windings while the machine was at the temperature of the run. These measurements were made by the so-called "fall of potential method," which is generally the simplest and most convenient for testing motor and dynamo windings. It is merely an application of Ohm's law.



CROCKER WHEELER MOTOR DYNAMO.

The storage battery was connected through a German silver resistance to the motor terminals, from which the field had been disconnected. The current passing through the armature was read on the ammeter in circuit, and the fall of potential between the motor brush terminals was observed on a voltmeter connected to them. The current and E. M. F. readings thus obtained were 7.8 amperes and 7.2 volts, respectively. Hence

$$\text{Res. of armature} = \frac{E}{C} = \frac{7.2}{7.8} = .92 \text{ ohm.}$$

Similar measurements were made on the dynamo armature and the field winding, using the 110-volt circuit and milammeter in the case of the latter, on account of its comparatively high resistance. The resistances computed from these tests were 0.11 ohm for the secondary armature and 382 ohm for the field. These values furnish us with the means of computing the "C^2R loss," in each of the three windings on the machine. For the field, since the impressed E. M. F. at the motor terminals was 107.2 volts, the current in the field winding during the run was $\frac{107.2}{382} = 0.28$ ampere, and the C^2R loss is, therefore, $.28^2 \times 382 = 29.9$ watts. Further, since the total motor current during the run was observed to be 7.1 amperes, the armature must have taken 7.1—field current=7.1—0.28=6.8 amperes, and the C^2R loss for the motor armature is $6.8^2 \times 0.92 = 42.5$ watts.

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The current delivered by the dynamo armature was 22.2 amperes. The resistance as just computed was 0.11 w.

$$22.2^2 \times 0.11 = 54.2 \text{ watts.}$$

Therefore the "total C^2R loss" in the machine is

$$29.9 + 42.5 + 54.2 = 126.6 \text{ watts.}$$

The difference between the input and the output during the test run was

$$761.1 - 539.5 = 221.6 \text{ watts.}$$

Of this loss in the combined machine we have seen that a C^2R loss of 126.6 watts is distributed among the three windings, leaving

$$221.6 - 126.6 = 95.0 \text{ watts}$$

as a loss which must be accounted for as the aggregation of small losses in the machine, comprising friction of the bearings and brushes, eddy currents in armature core and pole pieces of field magnet, work done in fanning the air by the armature, and hysteresis. These different losses are enumerated in the order of their probable magnitude in a well designed machine, and their total (95.0 watts in the present case) is sometimes called simply the "stray power" of the machine, in order to distinguish it from the more definitely measured C^2R losses in the windings.

Below is given in tabular form a recapitulation of the results of the above recorded test.

TEST OF 1 H. P. MOTOR-DYNAMO.—TABLE OF RESULTS.—ACTUAL RUN.

SPEED 1480 REVOLUTIONS.

	MOTOR ARMATURE.	DYNAMO ARMATURE.
Terminal E. M. F.	107.2	24.3
Total currents,	7.1	22.2
Watts	761.1	539.5

Net efficiency.....70.9 per cent.
Total Watts lost.....221.6.

Resistances—

	MOTOR ARMATURE.	DYNAMO ARMATURE.	FIELD.
Fall of Potential.	7.2	1.6	107.0
Current	7.8	14.5	.28
Resistance	.92	.11	382.
Losses—			
Current during Run	6.82	22.2	.28
C^2R " "	42.5	54.2	29.9

Total C^2R loss.....126.6 watts.
"Stray Power"..... 95.0 "

J. B. BAKER.

HAS GOT BACKING IN ENGLAND.

H. B. Cox, of Hartford, Conn., the inventor of a means of converting heat into electricity, is leaving to take up his permanent residence in England, where capital has been furnished him to engage in the manufacture of the apparatus designed to carry out his plans. The British government has already given Mr. Cox orders for 10,000 of his machines for the telegraph service. Sub-companies will also be formed in France, Germany, Belgium, etc. A strange feature of Mr. Cox's experience in this country is the fact that though he had $100,000 worth of bona fide orders from such companies as the Postal Telegraph Company, the Metropolitan and New York and New Jersey telephone companies, yet he could not raise $25,000 on them by which to carry on their manufacture.

The electric light, as it burns in every day use, converts electricity into heat. Mr. Cox says his invention is simply a reversal of this process. He says he converts heat directly into electricity, turning heat vibrations into electricity vibrations. The idea has been known since 1821. What he claims as his own is the making this practicable. He says the Commercial Cable Company, after putting it in daily use, declared that his machine did its work at one-eighth the present cost.

The uses that the Cox machine are designed for are to light private houses, for ship lights, for lighthouses, for telegraph and telephone, for electric bells, for boat propulsion and the general purposes of small motors. Lord Kelvin (Sir William Thompson) is cited by Mr. Cox as pronouncing this invention most remarkable, and just what is needed."

SACREMENTO CARNIVAL.

Successful Celebration of the Long Distance Transmission of Power—Brilliant Illumination.

The carnival or Fiesta, held in Sacramento Sept. 9th, in celebration of the recent introduction of almost unlimited horse-power of electricity from Folsom, twenty-two miles away on the American river, was a brilliant success. It was the grandest demonstration in the way of fiesta ever held in California, which is noted for flower festivals, water carnivals, etc. Sacramento is a city of nearly forty thousand people, and there were at least twenty-five thousand visitors there from all parts of the state. The city was illuminated from one end to the other by electric lights, in carnival colors, green, gold and red, and the sight was brilliant and grand in the extreme. The beautiful state capitol building, from basement to dome, 300 feet high, was one mass of shimmering lights in these colors, while stately cedars in the foreground were literally covered with them. Many of the street designs were unique, and all were beautiful. The procession was two miles long, and was largely composed of magnificent floats, most of which were propelled along the street railway tracks by trolley power, by which agency, also, they were illuminated. There were upwards of twenty of these floats in the line, all blazing with colored lights, and nearly all representing some important branch of industry, a few being of allegorical character. Those who have witnessed carnivals in New Orleans, and other cities of this continent and Europe, say that they never saw anything to quite equal Sacramento's Electric Carnival, in point of beauty and grandeur. On most of the floats machinery was at work, with artisans in their places all dressed in becoming costumes. Each department of the Southern Pacific Railroad Company's vast shops was represented, with nearly three thousand workmen in line. The city was also beautifully decorated in carnival colors all along the business and residence streets, while the public thoroughfares were one solid mass of humanity all along the line of march. There was hardly a foot of business streets that did not blaze with electric lights, and people simply wondered at the grand spectacle that greeted them at every turn. The Sacramento Light and Power Company were able to provide electric power for all this display without calling on more than one-half of their plant. Two more immense generators are being added, and when these are in place the company will be prepared to furnish 10,000 horse-power, enough to turn every wheel of industry in the city, and to supply farmers along the route of transmission with power for pumping water for irrigation and other purposes.

The people of California have heretofore had little conception of the vast power that nature was ready to give them for the asking, but now that Sacremento has demonstrated the fact that electricity can be transmitted more than twenty miles, at a loss not to exceed ten per cent, it is expected that many of the mountain streams that pour into the great valleys of the Sacramento and San Joaquin, for a distance of over five hundred miles, will be utilized to generate this new and wonderful power. Sacramento may well be proud of her distinction as pioneer in this new field of electric science, and while her carnival was something grand and beautiful to the eye, it had a significance that goes far beyond the mere glitter and show of illumination. It told of a new agency, of the vastness and cheapness of whose power but few had dreamed.

PHONOGRAPH IMPROVEMENT.

According to telegraph advices, a deal has been completed between George W. Moore, an engineer of Atlanta, Ga., and the Edison company, whereby the latter acquires an appliance recently invented by Moore. It consists of a combination of ten or more cylinders which may be attached to the phonograph, and which work automatically, rendering it capable of receiving any number of letters in dictation or of playing an indefinite number of musical selections. It can be attached to phonographs already constructed. It is claimed that the new appliance will be of special value in large offices where many letters are sent out daily.

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ELECTRO-THERAPEUTIC DEPARTMENT.

INDUCED CURRENT ACTION IN THERAPEUTICS.

Methods of Application and Physiological Effects in Gynaecology.*

In employing periodic induced currents for therapeutic purposes several things must be taken into consideration, viz.:

1. Whether the current is an interrupted current of one direction or a truly alternating current.
2. The comparative relation of two qualities of the current e. m. f. and volume or amperage.
3. The frequency of the periods or interruptions.
4. The duration and method of application.

Since everything of which these currents are capable therapeutically depends upon the degree and character of the stimulation they produce, the importance of a consideration of these points is self-evident.

If we recognize in the interrupted induced or faradic current a current of one direction endowed with polarity, which we must do if only the break current has sufficient e. m. f. to be appreciable through the resistance of the human tissues, it must be admitted that this current is capable of exerting some electrolytic action, though it may be slight. It is a demonstrable fact that the faradic current does produce electrolytic action, and that it is a current of one direction, when employed through the resistances of the human tissues. For this reason I have designated it an interrupted, induced current. It is true that through low resistances, such as a galvanometer placed in the circuit, it appears to be an alternating current, since upon making and breaking contact of the vibrator slowly the needle will be deflected to an equal degree on either side. But the make and break currents are of such unequal force (the break current being estimated to be thirteen times stronger in e m f than the make current) that when applied through resistances like the structures of the body the break current only has sufficient force to penetrate and produce an impression, and it is only this phase of the current which we need take cognizance of. As a proof of this, take a sponge electrode in each hand, turn on the current, and make and break contact at the vibrator slowly. A contraction is produced only when contact is broken at the vibrator, and no sensation is experienced when contact is made. To demonstrate that this current does exert an electrolytic action, take a solution of starch, to which some iodide of potassium has been added, and insert into it electrodes of fine platinum wire connected with the terminals of the secondary circuit. A few seconds after the current has been turned on a discoloration will be noticed at one pole due to the formation of iodide of starch. The difference of the amperage of the current from the fine and coarse wire coils can likewise be demonstrated in the same manner. With the current from the long fine wire coil the discoloration is scarcely noticeable, whereas with that from the short coarse wire coil the re-action is very pronounced. Since the amperage of these induction currents as employed in medicine is insignificant by comparison with even the weakest constant current used, the electrolytic action may, in the main, be disregarded: yet we must recognize the effect upon nerve tissue, since an inverse current (or one in opposite direction to the nerve current) diminishes the functional activity of the nerve and a direct current (or one in the same direction as the nerve current) increases its functional activity. In this respect the interrupted current possesses an advantage over the alternating, which is constantly reversed and has no polarity, an advantage by no means to be ignored in certain conditions.

The stimulating property of these currents depends more, perhaps, upon the relationship of the two qualities e m f and value than upon anything else. Hence the advantage in favor of the interrupted induced or faradic current which is susceptible of greater variation than either the alterating or static induced currents. In the faradic apparatus the e m f and value of the current can be very conveniently varied by changing the length and size of the wire of the secondary winding.

The advantage then of a number of secondary coils, having different lengths of the same wire and different sizes of wire, is that the stimulating property of the current may be conveniently and gradually increased as desired.

The frequency of the periods has an important bearing upon the e m f of the current generated as well as upon the physiological effect produced. The more frequent the periods the more soothing the application as a general rule, and the more infrequent the periods the more irritating or stimulating they become.

The method of application is quite as important as any of the other points that have been considered, since a stimulation may be made exciting or soothing according to the manner in which the current is applied. For instance, if the current is applied so as to maintain a constant state of excitation throughout the application, causing the subject to experience a moderate degree of irritation during the entire period of its administration by constantly and rapidly increasing the strength, even the fine wire current will fall short of sedation and the structures to which it is applied will be left in a state of stimulation. If, on the other hand, the current is applied so that it is barely perceptible throughout the application, its strength being gradually increased as insensitiveness becomes apparent, and the application is continued until complete relaxation and insensitiveness are produced, the result will be a sedation.

The general effect of periodic induced currents then is a muscle, nerve and circulatory stimulation, the degree and nature of this stimulation depending upon the e. m. f. and amperage of the current employed, the rapidity of the impulses and the method of application.

One of the most important effects produced by these currents is stimulation of increassed tissue changes (i.e., increased absorption of oxygen and corresponding increased elimination of carbonic acid by the tissues), and coincidently increased nutrition. Hence, they increase the functional activity of organs brought under their influence. This effect of the current can be readily demonstrated. For instance, its power to increase perspiration may be shown by grasping in one hand the bipolar electrode and using the fine wire current as strong as it can be borne for a few moments. The hand becomes bathed in perspiration. Another effect observed is that the hand, but more particularly the fingers, soon become pale and bloodless, owing to the violent tetanic contraction of the muscles and the effect of the current upon the vasomotor supply. It is just this action of a powerful alternating current used in electrocution which causes the death of the criminal. As I pointed out in a recent contribution upon this subject the intense muscular contraction throughout the body forces the blood to the internal cavities and especially the brain, producing interstitial hemorrhages. This may be regarded as an exaggerated example of the effects of these currents upon the circulation.

Improvement in the general nutrition of the patient has often been noted, even when only local applications have been made to the female pelvis, the improvement in the general health being out of proportion to that of the local condition.

The effect of these currents upon the capillary and lymphatic circulation is marked and most important. It is no doubt that their power to promote rapid absorption of inflammatory exudates may be attributed directly to stimulation of the capillary and lymphatic circulation.

I will venture to offer an explanation of how this result is brought about.

Faradic stimulation quickens the capillary circulation:

1. By exciting an increased vermicular contraction of the

*Paper read by Dr. A. H. Goelet before the Toronto Convention of the American Electro-Therapeutic Association.

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smaller arteries the blood pressure is augmented. This causes momentary distention of the capillary vessels, the reaction from which, owing to their elasticity, empties or unloads them into the veins. In case of any obstruction in the capillary vessels this distention, together with the increased blood pressure, favors its removal.

2. By stimulating contractions of adjacent muscles the veins are emptied, and a void is created in their intervalvular spaces, which invites the blood from the overloaded capillaries.

Increased activity of the lymphatics is brought about by faradic stimulation:

1. By stimulating the process of absorption, and

2. By stimulating contraction of adjacent muscular structures, the circulation in the lymphatic vessels is increased. These vessels being supplied with valves similar to those found in veins, the contraction of surrounding muscles empties the intervalvular spaces, and invites the flow of lymph from the lymph spaces where absorption takes place.

As the result of this action upon the capillary circulation and lymphatics, pelvic congestion is relieved and rapid absorption of infiltrations and exudations is accomplished. This agent is unquestionably the most powerful, the most certain, and therefore the most valuable vasomotor constrictor which we possess.

Perhaps the most important effect of periodic induced currents of high e. m. f: and great frequency is the production of sedation and the relief of pain. As pointed out by Duchenne, the special action of these high tension currents is upon the sensory nerves, and it partakes of the nature of an excitation; but this excitation or stimulation will result in sedation if certain conditions are observed. This appears to involve an inconsistency; but you will recall the fact that opium is a cerebral and circulatory stimulant, yet its effect is sedative.

It is very necessary to understand that two results may be obtained from the application of fine wire currents in particular, viz.: stimulation and sedation.

Stimulation may be of two kinds: 1--Exciting, when it is irritating; 2—Sedative, when it is non-irritating and soothing.

Very much, therefore, depends upon the method of application in bringing about the result desired. If the current is applied so as to maintain a constant state of excitation throughout the application, causing the patient to experience a moderate degree of irritation during the entire period of its administration by constantly and rapidly increasing the strength of the current, the result will fall short of sedation, and the parts will be left in a state of stimulation. The application need not be painful to produce this result. If, on the other hand, the current is applied so that it is barely perceptible throughout the application, its strength becomes gradually increased as insensitiveness becomes apparent, and the application is continued until complete relaxation and insensitiveness are produced, the result will be a sedation.

The former method of application is adapted to moderately insensitive conditions for promoting absorption of exudates and relieving the engorgement of the pelvic vessels when no inflammation exists and pain is not a prominent symptom. The latter method of application is appropriate for the relief of pain, acute congestion (even inflammations) of the pelvic organs, and to promote the absorption of recent exudations, and, in fact, should be employed in all acutely sensitive conditions.

The duration of the application likewise influences the result. A five or ten minute application may suffice for producing the form of stimulation described above, but sedation, which will be prolonged and satisfactory, is seldom attained with an application of less than fifteen or twenty minutes' duration.

The relief of pain which follows the application of these currents in the manner described for producing sedation may be explained in this way, viz.: the rapid succession of impulses imparted by the interruptions may be regarded in the nature of a percussion, which induces a condition of concussion of the nerve filaments, impairing their function to conduct painful impressions. The intense stimulation of the motor nerves produces a tetanic contraction of the muscles, which eventually wears out their contractility, producing relaxation or a temporary local paralysis that means rest for the diseased parts which they encompass. It is probable, also, that relief of the congestion upon which the pain may in great measure depend is another way in which this result is reached.

The rapidity of the interruptions has likewise an important bearing upon the result, since the more rapid they are the more soothing in effect. Therefore, for a sedative effect, they should be as rapid as possible. In using the coarse wire current for muscle stimulation, however, the interruptions should be slow, so as to allow an alternate contraction and relaxation, similar to the normal physiological action of the muscle.

The frequency of the applications and the subsequent behavior of the patient are also to be considered. Three times a week may be sufficient when a stimulation is required, and the patient may not be restricted in her movements especially to attain this result. But sedative applications should be made every day, in some instances several times a day; and, to be productive of the best result, they should be made after the patient has retired for the night, or she should be made to recline for at least an hour or two afterward. This is not always essential, however, for in very many instances the relief obtained continues for hours, even when the application is made in the physician's office and the patient is permitted to exercise moderately afterward.

As a therapeutic measure for the relief of pelvic pain and congestion, and pelvic inflammations and their results, infiltrations and exudations, this form of electricity is incomparable with any other agent which we possess. It is to be regarded not only as a remedy against the symptoms accompanying diseases of the female pelvic organs, but often as a curative agent as well though frequently it serves only as an auxiliary to other measures. In cases where the disease is so far advanced that a cure cannot be effected and some radical operation is necessary, it serves an exceedingly useful purpose in placing the patient in the best possible position to withstand it, and aids its success by improving greatly the local condition and her general nutrition.

The coarse wire current is particularly serviceable where there is loss of muscular tone and venous engorgement, such as in subinvolution; but it is absolutely contra-indicated in sensitive and inflamed conditions.

I have purposely laid more stress upon periodic currents of high frequency and high e. m. f. because they cover a larger field of usefulness.

APOSTOLI'S CONCLUSIONS.

The Therapeutic Effect of Alternating Currents of High Frequency and High Tension.

Dr. Georges Apostoli, of Paris, presented a paper before the American Electro Therapeutic Association at the late Toronto meeting containing a summary of his conclusions in reference to the general therapeutic effect of alternating currents of high frequency and high tension. His statements follow:

1.—According to Professor d'Arsonval's discoveries alternative currents of high frequency and of high tension, exert a powerful action upon all living bodies submitted to their inductive influence.

2.—The best method of applying these induced currents is to place the patient, free from all contact with electrodes, in the circuit of a large solenoid traversed by these currents.

The patient being thus completely insulated the currents, which circulate in his body by *auto-conduction*, have their origin in his tissues. The body plays the role of a closed induced circuit.

3.—By this method the physiological discoveries of Professor d'Arsonval are confirmed and we are able to prove the powerful influence of these currents upon the *vaso-motor* system—although they produce absolutely no sensation and although they have no apparent effect upon the motor or sensory nerves.

These currents have nevertheless a powerful action upon all the nutritive functions; as has been verified by Dr. d'Arsonval's

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numerous analyses of the gazeous products of respiration and by Dr. Berlioz's not less numerous analyses of the urinary excreta.

4.—The general therapeutic applications to be deduced from this physiological action are confirmed by clinical observation.

Dr. Apostoli has now treated more than a *hundred* patients by this method at his clinic and at his private consultation rooms. The greater number of these patients have been greatly benefitted by this new treatment which, be it remarked, has been used to the exclusion of all other forms of medication, dietetic or otherwise.

5.—These currents exert in the majority of cases a most powerful and generally beneficial action upon diseases due to *slackening of the nutrition* by accelerating organic exchanges and combustion. This is proved by analyses of the urine made by Dr. Berlioz, of which the following is a brief resume:

The quantity becomes more normal; the products of organic waste are better eliminated.

The *increased combustion* is shown by the diminution of *uric acid*, while the percentage of *urea* is generally increased. The relative proportion of these two substances changes under treatment so as to reach in general the figure of 1-40.

The elimination of the mineral products is also changed, but in a manner less marked.

6.—When daily seances are given, each lasting fifteen minutes, we may generally observe in patients submitted to the influence of these currents the following modifications in their general condition. We mention them in the order of their occurrence:

Return of sleep.

Increase of strength and vital energy.

Increase of gaiety, of power for work and ability to walk.

Improvement of appetite, etc.

In short, *general progressive improvement.*

This general improvement often manifests itself after the first seances before any local influence is apparent and before any change has occurred in the urinary secretions.

7.—Local pain and trophic changes are often more slowly affected by these currents and at times they are entirely refractory for a longer or shorter period.

In such cases the same currents must be applied locally by contact with the electrodes.

This subject will be treated later on in a separate communication.

8.—The diseases which have appeared incurable by this treatment are those not associated with well defined organic changes such as *hysteria* and certain forms of *neurasthenia.*

Dr. Apostoli has also observed that certain *localized neuralgias* are refractory to this form of currents; they require its more direct local application.

9.—The diseases which have derived most benefit from this therapeutic agent, belong to the *arthritic class: rheumatism* and *gout.*

10.—In certain *diabetic* subjects the sugar has disappeared altogether from the urine under the influence of these currents, while in others there has been no such change notwithstanding the manifest and constant improvement in the general condition.

Is this difference due to the imperfection of the electric apparatus or to the manner of its application? It is hoped that further experience will soon afford an answer to this question; although the fact that diabetes has many different causes, may in itself explain the difference in the results obtained by this treatment.

11.—In conclusion, the currents of high frequency and of high tension introduced into electro therapeutics by Dr. d'Arsonval greatly increase the field of action of medical electricity.

They furnish general medicine with a new and valuable means of treatment, capable of modifying more or less profoundly the processes of nutrition.

Rhythmic tractions of the tongue are strongly advised by the Phasmazentisches Centralblatt in the treatment of electric shock.

Dr G. Betton Massey reports a case of large, intra-uterine cystic fibroid destroyed piecemeal by repeated applications of bipolar local electrolysis, resulting in a satisfactory cure. A four-pronged bipolar instrument was employed; the prongs were buried in the projecting portion of the tumor and a 700 milliampere current applied for six minutes. This treatment was repeated daily. In three months the tumor was eradicated and two years later the patient was in good health. Dr. Massey also reports a case of sarcoma of the left tonsil and soft palate cured by electrolysis, followed by zinc-amalgam cataphoresis.

Dr. W. Scheppegrell, of New Orleans, describes in the Medical News of August 10th a new and simple method by which cautery irons may be electrically heated almost instantaneously. He uses the jar of an ordinary bluestone battery which is three-quarters filled with a solution of borax, one part; sodium carbonate, ten parts, and water to make a density of 1,060. A plate of lead one inch wide is coiled around the bottom of the jar and to this is soldered the positive terminal. The negative wire is passed across the top of the jar. The wires are connected with the Edison current system of 230 volts. Ordinary cautery irons are used. The neck of the cautery iron is brought in contact with the negative wire and as the point of the cautery touches the solution, it immediately becomes red-hot, and if left longer in the solution, white-hot. The intense heat generated is not due to the resistance, but to the fact that when the electric current is passed through the solution, electrolysis takes place: oxygen is liberated from the positive terminal and hydrogen from the sustained which is in contact with the negative terminal. This layer of hydrogen has a high resistance and becomes intensely hot, and the heat is communicated to the instrument. The heat of the hydrogen also causes it to combine with the oxygen of the air and by this combination the heat of the cautery is increased. The advantages the author claims for this method are simplicity, reliability and economy.

ELECTRIC KENO.

A new game of chance has been devised, in which the ordinary electric fan plays an important part. The only requisites are the "current," and a goodly supply of nickels or larger coin.

The rules governing the game are simple. Each of the blades is numbered, the numbers running from one up. A corresponding set of numbers and small circles is marked on a sheet of paper, and the game proceeds. Each player covers a number with a nickel, the current is turned on, and the fan buzzes gaily for a minute. Then it is suddenly shut off, and as the revolutions grow slower, every player watches to see which blade will be uppermost, the center of the screen having been marked. The man who covers that number wins all the money, the numbers are again covered, and away goes the fan for another whirl.

AN ELECTRICAL PHENOMENON.

F. J. Bacon related a circumstance this morning, which, in this country where electrical disturbances are not common, is quite out of the ordinary, says the East Oregonian. He lives seven miles south of Pendleton on a ranch. Wednesday evening Mrs. Bacon was preparing supper and had the usual assortment of cooking utensils on the stove—iron, tin and earthenware vessels. The wind and dust storm came up, and accompanying it were heavy thunder and vivid lightnings. She noticed something queer about the utensils and soon found that she could not use the iron stove handle, for when the vessels on the stove were touched by it, brilliant streams of electric sparks were emitted, and she received shocks which caused her to drop the handle instantly. Mr. Bacon was called to the kitchen, but he found that electricity is no respecter of persons. The currents had grown stronger by this time, and he was soon executing a hornpipe and pirouetting the room, making wry faces and compelling Mrs. Bacon to laugh violently at his antics, though some frightened at the presence of their mysterious visitor. The couple finally succeeded in putting out the fire and removing the vessels, and with the passing of the storm center the magnetic guest went up the chimney and out into the open air.

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STREET RAILWAY CONVENTION.

Annual Meeting of the New York State Association—Important Papers to be Read.

The annual convention of the New York State Street Railway Association will be held in Albany, beginning Tuesday, September 17. The meeting will be a most interesiing one, if the list of papers to be read may be taken as any indication. The subjects to be discussed are as follows:

Points on financial organization.

Car mileage record—its advantages.

Improvements needed in electric motors.

Suggestions for special track construction.

How can we increase travel, especially in smaller cities?

Are we laying too many miles of track to reach a few people?

Is selling tickets at reduced rates an advantage or disadvantage?

The maintenance of power station from an economical standpoint.

How to keep car bodies clean—A plan for daily inspection and care.

Fenders: Are they practicable?—Their advantages and disadvantages.

Is a freight or mail service profitable or unprofitable on street railways?

The use and abuse of transfers, and are they advantageous in smaller cities?

Overhead construction: maintenance of same, and suggestions for new work.

How can we prevent accidents and increase the general efficiency of employes?

How shall we heat cars?—The relative cost and advantages of electricity and stoves.

General track construction and the most approved method—Suggestions for improvement.

How to prevent collusion on the part of motormen and conductors to defraud the company?

The best method of and the advantages gained by rotating crews and distribution of runs.

The relative advantages and disadvantages of single and double trucks for inter-urban service.

Can small electric roads be operated to advantage in conjunction with small electric light companies?

Report blanks, time sheets, etc., and their general usefulness to the superintendent. Suggestions for forms.

The daily inspection and care of car equipments—How to accomplish the best results with the least expense.

The daily record-book of conductors' returns. Its necessity and advantages—Suggestions for headings.

The best method of promoting personal interest on the part of the employes in the affairs of the company.

Signals and inter-communication with reference to maintenance of schedule on single track street railroads.

The proper form of liability insurance—Can a company insure itself to advantage by establishing a fund?

What is the proper and most efficient method of protecting a street railroad company from dishonesty of employes?

Street car wheels—Should they be made heavier, to avert possibilities of accident?—Is it possible to establish a standard?

Street railway legislation—How can it be met to best subserve the interests of street railroad companies and the public?

The comparative advantages or disadvantages of operating long or short cars. The extra expense and increased capacity considered.

How shall we prevent pounding down of track joints?—How shall we remedy the evil, when it exists, without replacing entire track?

Power from the trolley circuit?—Is it practicable?—Why do the fire insurance companies object?—What should be done to overcome the objection?

Pleasure resorts and their advantages to street railroads—Are they profitable? How should they be conducted and maintained to attract the largest number of people and secure permanency?

Can cities of less than 15,000 inhabitants support a street railroad of moderate mileage, carefully and well built at present prices, without over-capitalization of costs, owned and handled by local parties?—What measure of profit can be expected therefrom?

YOUTHFUL ELECTRICAL GENIUS.

Wilhelm Neidergesaess, who lives near Smith's Cove, is quite an electrical genius, says the Seattle Times. The young man is but 18 years old, but has already demonstrated that he is a mechanical genius. His home is situated on the bluff overlooking the sound. The bluff is 180 feet high and a small stream of water runs down its face and mingles with the salt water of the sound. The latest boat built by young Neidergesaess has accomplished a great deal towards making electricity add to his comfort.

The stream running down the face of the bluff forms the basis of operations for the young electrical genius. A few feet from the house a large wooden tank has been constructed, to hold a surplus supply of water. From the tank a three-inch pipe is laid to the foot of the hill, where it enters a small workshop. There it operates a three-horse power water motor, which drives a ten-light dynamo. From the dynamo two wires conduct the electricity back up the hill to the house, where it is put to a multitude of uses. It lights the house, saws the wood, pumps water, grinds the coffee and operates an experimental searchlight. The whole plant is automatic in its operation and requires no attention whatever. There is practically no expense attached.

But the most interesting feature connected with the plant is an electric boat; the craft is 12 feet 6 inches long and 1 foot draught, and has a displacement of 1,000 pounds. It is driven by a motor of the Manchester type, directly connected, running at 500 revolutions, the screw propeller being eight inches in diameter and with an 8-inch pitch, and using ten cells of storage battery to operate it. They are each of 100 ampere-hour capacity, and will drive the boat from five to six miles an hour for twenty-five miles at one charge. The boat which is much more seaworthy than an ordinary launch, will seat four persons with comfort. The motor and batteries are very compact, being all under the seats out of the way, and to an ordinary observer the boat resembles an empty row boat. Everything about it, including batteries and motor, are of very simple construction, and were made by young Neidergesaess.

DAMAGE BY ELECTROLYSIS.

Omaha Water Company Institutes Suit Against Omaha Street Railway Company.

A damage suit for $250,000 has been instituted by Receivers Bierbower and Hunt for the Farmers' Loan and Trust Company, of New York, bondholders of the Omaha Water Company, against the Omaha Street Railway Company, for alleged damage done to the mains of the plaintiff by vagrant electricity from the motor wires of the defendant throughout the city. The plaintiffs allege that the damages already sustained from such cause have cost the water company a large sum, necessitating the replacing of large reaches of mains. The court is asked to assess such damage upon the street railway, and compel it to remove the menace to plaintiff's mains.

Z. S. Spaulding, who lately acquired from the Hawaiian government a franchise for a cable line between the Sandwich Islands and San Francisco, is at present in Washington, and at an early date will submit a proposition for laying a cable and will ask for aid from the government. Colonel Spaulding expects to get private subscriptions to the amount of $1,000,000, and expects the United States government to do the balance.

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

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The Competition of the Gasoline Engine.

Within a few days some advertising circulars came to me through the mail which indirectly compare the cost of electric current when generated by isolated and by central station plants. Figures are given which purport to be averages of the expenses shown by the records of a large number of stations of each kind, and the startling conclusion must be drawn from these statements that the generating cost including interest, in isolated plants is less than the cost in central stations, exclusive of interest. In such comparisons it is always difficult to present satisfactory figures on account of the widely differing conditions which are met in different stations, but averages made up from the results taken from the records of a large number of stations should present evidence which is worthy of careful examination on the part of those who have financial interests in central stations.

The figures in question doubtless refer to isolated plants of considerable size using steam engines as prime movers, but there are not a few central stations in the West which find keen competition from small isolated plants driven by gasoline engines. These plants are set up in the basements of stores or other establishments in towns and small cities, and require so little attention that a clerk or porter may look after them. In this way charges for attendance are virtually avoided, and the total cost of electrical energy thus generated (including a liberal allowance for interest and depreciation), may be reduced to figures between twelve and eighteen cents per thousand watt hours, in plants that have as small a capacity as thirty sixteen-candle power incandescent lamps. The gasoline engine offers even greater advantages to the small power user in reducing the cost of power, and the competition which it offers to the central station that operates a power circuit is of the sharpest kind. There is no denying that some of the gasoline engines now on the market have much merit, and will certainly remain in permanent competition with electric motors supplied by current from central stations.

If the average central station cannot compete in the cost of generating current with the average isolated plant driven by steam, it makes a proportionately more unfortunate showing when compared with the smaller plant driven by a gasoline engine. For this condition there is no remedy except that of introducing greater economy in the generating expenses. Unfortunately the word economy is merely a relative term; it does not mean retrenchment which injures the service of the company, brings it into labor troubles with its employees, or induces the purchase of inefficient apparatus or defective supplies; it does mean a proper use of the minimum amount of the best material and the best directed labor, and a decreased generating cost per unit of output for each succeeding year. This kind of economy can only be brought about by applying a carefully considered system of central station accounting similar to that used by manufacturers with a strictly drawn responsibility for all expenditures of material and labor. The bookkeeping of the average central station is generally immaculate in appearance, but entirely omits its most important factor—the manufacturers, account—and the proper co-ordination between the generating accounts and consumers accounts is seldom maintained.

Advances in Electro-therapy.

The American Electro-therapeutic Association has just completed its fifth annual meeting. This year it met in Toronto, and, while the attendance of members was not so great in the Canadian city as was expected, and the amount and value of the work done was not quite up to the standard set by the former meetings, yet many creditable papers were presented, and the discussions were lively and interesting. There are certain features in the plan of work adopted by this association which it would be well for other organizations, created for the mutual improvement and the advancement of knowledge among their members to take note of.

Five years ago electricity, as applied to medicine and surgery, was in a very chaotic condition. There was no uniformity in appliances or practice, no instruments for exact measurement, no facilities for obtaining the needed preparation for the practice of electro-therapeutics, no exact information regarding the appropriate use for the various forms of electrical energy in the treatment of disease.

A radical change has been wrought in this state of things by this association. In the beginning it promptly set itself about clearing the ground of chaff and rubbish, and developing a science of electro-therapeutics out of the solid facts which physics and physiology had to offer.

Certain men, whose experience had taught them the value of electricity as an aid in checking the ravages of disease, had the courage of their convictions and did not hesitate to flood with the light of pure science their field of operation. Men, eminent as electric engineers and teachers of physics, were invited to join them to aid in separating the sound from the unsound, the true from the false, in that which had been taught and practiced as electro-therapeutics. By their aid a foundation of solid fact has been established, and charlatanism, which has long been in possession of this valuable territory, has begun to lose ground, and the claim of electricity, as a factor in therapeutics, has begun to receive respectful attention from medical educators and able practitioners the world over. The machinery through which this association has been able to effect this result, in so short a time, has been the establishment of standing committees composed of competent men, some practitioners of medicine or surgery, others not, whose duty it is to examine, test, and annually to report upon the mechanical construction, electric action and efficiency, and the physiological and therapeutic effects of the various instruments designed and recommended for therapeutic work. The work of these committees continues the year round. Manufacturers have welcomed and aided their efforts, and the result has been a steady progress toward simplicity and uniformity in the appliances produced, and a greater unanimity in

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the results reached in practice. By this plan the progress of electro-therapeutics is made to keep pace with the rapid strides in electrical science, and every discovery in methods of generation and transformation of electric energy finds therapeutic application, when this is possible.

Electricity in all its manifestations has an intimate relationship to living animal organism. It has its part to play as one of the forces upon which life processes depend. It must, therefore, have a legitimate place in the readjustment of those processes when they go astray, and we are pleased to see that rational methods are in operation to detect what electric energy has to do in the sphere of physiology, and how it can be turned to account in bettering man's condition by arresting and correcting abnormal states of the body.

* * *

The Niagara Franchise.

There seems to be great need of wise counsel, not to put too fine a point upon it, in the dealings between the city of Buffalo and the Niagara Falls Power company. The city council has been asked for a franchise by the power company which proposes to supply light and power to it and its citizens. The franchise has just been offered, but embodies conditions that make its acceptance impossible. Some of these conditions are extremely onerous and unnecessary. One is that the company shall be compelled to supply pole line capacity for two other companies each as large as its own. Another is that, while poles may be used at the beginning, they may be ordered down and conduit transmission substituted unconditionally and at any time by the Buffalo council. A third objectionable clause is the levying of a five per cent tax on the gross receipts beginning at once. The final and certainly the most impossible condition is that the city council may, after ten days' notice, declare the franchise forfeited for any alleged violation of its provisions.

The strings to this franchise would do credit to a New York or Chicago legislative body. It will be noticed that all the provisions tend to give the council the right of continuous interference—to enable that body to levy a constant blackmail on the company. Of course, beside that reason why these conditions are difficult to meet, there are others that can be made more specific. For instance, no capital will rush into business, where a tremendous outlay is necessitated, and when big bonuses are demanded at the outset. Nor will capital care to submit to the provision limiting its possibilities to a period of 25 years, especially where the service to be rendered means as great an outlay, as it does in this case. The bonds of the company moreover extend over a period of 36 years, and naturally their holders would want to know that there would be something definite on which to depend for interest even to the last.

Taking it all in all, it looks very much as though the Buffalo council felt that the power company is in its power, and compelled to submit to any conditions, no matter how odious. We do not understand this to be the case, and there is no good reason why the power company should not do business elsewhere until the Buffalo council grows reasonable.

We are not protectionists, in the ordinary acceptation of the term, but we do believe that when men take such risks as the Niagara people have done, they ought to be protected and given the full benefit of their enterprise, at least for a reasonable time. There is no question that the English government would have been glad to stand behind Col. North's company, if there had been found any English or Canadians willing to back the enterprise on the Canadian side of the river, but the "bold Britisher" preferred to wait until Yankee pluck had taken all the risks and demonstrated the success of the immense conception. Now John Bull announces that his subjects will build a plant on the Canadian side, only better than we have done, and it would be a repetition of history for him to do so and compete in Buffalo for this same franchise. Or is it, perhaps, English money now that has biased or bought the Buffalo council and prevented the execution of a franchise of reasonable conditions?

* * *

Responsibility for Electrolysis.

The suit which has been filed by the receivers of the Omaha Water Company against the Omaha Street Railway Company for damage to its mains by electrolysis, opens up a question which is of as much general interest as any other that has come before the courts for a long time. In every city and every town throughout the country there exists practically the same conditions as are found in Omaha. Every place of any pretentions has water, gas and sewer pipes, and has, as well, an electrically operated street railway. The electric current used by the railways returns to its source of supply through the rails imbedded in the ground, and, in doing so, there is a greater or less escape into the ground. This vagrant current finds its way to the gas, water and sewer pipes, causing electrolysis in them. The responsibility for this is what the Omaha Water Company seeks to place upon the Omaha Street Railway Company, and the outcome of the suit will be watched with the greatest interest.

To arrive at a just estimate of the responsibility of a street railway company in a case like this, it would be necessary to know the exact facts. If, for example, it can be shown that the railway company had not used ordinary precautions to guard against damage of the kind complained of, then it would be an entirely different case from what it would be if such precautions had been taken. If the trouble arises, say, from improper bonding of the rails, then the company would be at fault for not using proper care in the matter. But if, on the contrary, everything has been done that the present status of the electrical science has suggested to guard against electrolysis, then it would seem that the railway companies can not be held responsible for something they clearly have no means of obviating.

* * *

Those Distracting Bloomers.

The Chicago Telephone company has issued an edict against bloomers, and Superintendent Zeublin gives as the reason that "one of our girls, who has a very trim figure, came to work one day wearing knickerbockers, which fitted her closer than the regular bloomers, and of course"—but why go further and finish Mr. Zeublins' humiliating confession. Of course, the girl looked well and of course she "attracted," or, as Mr. Zeublin expresses it, "distracted" the attention of the other employes. If Mr. Zeublin were the paid agent for a bloomer tailor, which we do not charge specifically, he could not, in any other way, do more to popularize the new order of things. But the cat is out of the bag. The admission is made—and by a man—that a girl, "with a trim figure" "distracted" more attention in bloomers than without them. What more do we want? The plea of "comfort" alone would never have made bloomers universal, for when did a woman ever yield to "comfort" as against "distracting attention?" Why, bless her heart! that's her principle business in life. And if so excellent an authority as beau Zeublin has been "distracted," he has the prescription that we have long been seeking. But we have not done yet. We want the name of the tailor employed by "one of our girls." The man who has built even a single pair of bloomers that showed off to advantage a "trim figure" and caused it to "distract attention" is entitled to the patronage of the "distracting" sex, and the homage of the "distracted." So let's have his name, Mr. Zeublin, and more power to his shears! And then—down with the edict against the bloomers!"

* * *

Congressman McGann, and his fellow stockholders of the General Railway company of Chicago, ought to be told, since they seem not to know it, that almost all their troubles grow out of trying to run a railroad in the courts. A little less law and lawyers—and a little more railroad management would be greatly to their advantage.

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Trolley Car Mismanagement.

A child was run over and killed by a trolley car in Brooklyn recently, and the motorman in extenuation said that "he was drowsy at the time from overwork," the inference being that if he had not been drowsy the accident might have been averted. He said that he had worked all Thursday and until one o'clock Friday morning, then went on again at three o'clock the same morning, having had only two hours' rest. He reported to the night foreman that he was unfit for work, and asked to be relieved, but was refused.

From the standpoint of those who are interested in the accident in the child's behalf, this will serve as pretty good evidence to establish a case of damages against the company; but what shall be said for the company? Serves them right if they get mulcted in heavy damages? That is not enough. The case is one which offers no palliation. Brooklyn has hundreds of capable men out of employment who would snap at a position as motorman. While this is the case there can be no acceptable excuse for overworking men to the point where they become incapable of exercising ordinary care, to say nothing of the more than ordinary caution that is incumbent on those who drive a car at rapid speed through the crowded streets of a city. It is just such criminal stupidity and bad management that has given rise to the widespread opposition to electrical traction and in the interest of the service in general, such flagrant neglect of ordinary precaution should be severely dealt with. An indictment or two for manslaughter would doubtless have a most salutary effect.

* * *

Questionable Telephone Methods.

It begins to look a good deal as though the Harrison Telephone Company was "a delusion and a snare." The announcement is made that in Terre Haute, Fort Wayne, Anderson, Richmond, and other cities of Indiana, the company has surrendered its charter and left the field without so much as giving a plausible excuse for its action. In Detroit, where an ordinance had been secured which required a deposit of $25,000 as an evidence of good faith, a very suspicious delay in putting up the money is caused on the flimsy pretext that some of the officers are out of the city. The Harrison Telephone Company may be in the field for legitimate, honest competition, but appearances do not favor that assumption. There is a screw loose somewhere and it ought to be located at once. If the Harrison people are merely a sandbagging concern it would be a matter of interest to the business men of the cities where they seek a franchise to know it. They are eager for the best possible telephone service they can get and they want it upon the most advantageous terms, but they will not lend themselves to any scheme of "holding up" existing companies for the sole purpose of allowing some bandit concern to rob them and then skip with the proceeds.

* * *

Will St. Louis Resume Its Bondage?

There is some talk in St. Louis of going back to gas lighting for the streets and alleys of the city. This follows close on the heels of a decision by the supreme court of the state that the Laclede Gas Light company has no right to run under-ground conduits through the city streets, under its old gas charter, and all the ear marks are present that the old gas clique is again in evidence. It was temporarily whipped some years ago by the two electric companies, and close contracts for street lighting are now in force. Since then the Laclede company has obtained control of both electric lighting companies, but without doubt they are finding that electric light is an honester light than gas, and there are fewer opportunities to rob the people. Moreover the Sutter franchise for a municipal subway has been in the way of the Laclede company for a long time, and if they can force gas on the city again they will ruin the Sutter people and the line of progress they represent. The Laclede people have fattened for many years, on wrecked corporations, and they are about out of provision.

The practice of stopping street cars at the near, instead of the far crossing of street intersections, bids fair to become general, and it is a change which will be generally approved. In several cities in the East that method has already been adopted, and now the Chicago railway companies announce their willingness to follow the same plan as soon as formal request shall be made of them by the city council. Practically it is just as convenient for the railway companies and for the traveling public as the old method, and it will tend to materially reduce the liability to accident. Instead of rushing across a street at high speed, with scarcely a warning to vehicles or pedestrians, the speed will be slow just at that point and will give ample opportunity, both to the motorman to give warning of his approach, and to the public to clear the right of way.

President Emerson McMillan, of the Laclede Gaslight company, of St. Louis, says that only for certain "ifs" it would be possible to light city streets with gas for one-half the expense of electric lights. Somebody should remind Mr. McMillan of the old nursery rhyme which says, "If ifs and ands were pots and pans," etc.

"When Greek meets Greek, then comes the tug of war." The Siemens-Halske company has locked horns with the Metropolitan elevated railroad, and indirectly with the General Electric company, and the result promises to be a legal battle which will be fought to the bitter end.

The Atlanta Exposition stands sadly in need of a bureau of Publicity and Promotion that understands the art of promoting. If the management could only have enlisted the services of Major Handy it would have been different. A little expensive, perhaps, but effective in proportion.

There seems to be a good deal of wind about the advocacy of compressed air as a substitute for electricity for power purposes.

The "Trilby foot" will never be popular with the gas companies. It is too large for the standard of meter measurement.

No, "Anxious Inquirer," the headline in the daily papers, "sparks from the wires," does not refer to a defective circuit.

* * *

Capital Punishment and Electricity.

If excuse should be required for a discussion of the ethics and morals of capital punishment in these pages of an electrical journal, that excuse may be found in the frequent and growing protests against the electric chair as a means of carrying out the laws of the land, and especially as these protests are coming to assume the form of general diatribes against capital punishment as a criminal code. It has been suggested in important quarters that the abhorrence of the people to capital punishment began with the use of electricity for that purpose, and is due to the horrors of the electric chair at Auburn and Sing Sing. We do not believe this to be the case, but on the contrary we believe that the same sentiment which demanded the substitution of electricity for the rope, is likewise responsible for the sentiment against capital punishment. There is no doubt that capital punishment is a relic of barbarism, and if we go back down the ages we will find that the taking of human life was not only common, but that it was legal for the most trivial offenses, and the darker the age into which we peer, the more trivial the offenses for which the death penalty was provided; and as we come down to the present day we find that capital punishment becomes less frequent, and that the crimes for which it is allowable have been reduced to that of murder, although the statute books of some of the states still contain a provision for capital punishment for the crime of rape and like offenses.

Wherever we are obliged to defend the law of capital punishment we fall back upon the biblical injunction, "An eye for an eye, and a tooth for a tooth," but we do not compare the age for which this biblical injunction was issued with our own, nor would we be likely or willing to answer for some other biblical

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injunctions, which were no doubt good in their time, but which would not be good in our day, and the only other excuse we can give for the taking of human life is, that it is in the interest of society and for the protection of the rest of mankind from one who is so outside the pale of law as to go about committing crime upon the members of society. It is undoubtedly the duty of society, through its organized departments, to protect itself, but there are other means of protection which would be equally as effective as butchering the offender, and one of these means is complete withdrawal of the offender from a position where he can do harm, in other words, solitary confinement. If we punish by this method we do not intrude our egotism beyond the grave, and we do not affect the power to send a fellow creature to his eternal reward, whatever our religion may assume this to be, and yet we surround society with all of the safeguards necessary, and we give the offender an opportunity, alone and without fear of death, to atone in his own way for his misdeeds. So why not solitary confinement for murderers and other offenders against the law? Psychologists will tell us that murders are epidemic, and that a great encouragement to murder is the newspaper notoriety acquired during trials of offenders. There are some minds so weak and so nearly unbalanced that the glamour of a picture in the paper, sensational headlines, and a crowded court room, are enough to justify the committing of the most heinous offenses, and there is no doubt that Guiteau and Pendergast were creatures of this sort.

If we will take our murderers, and other offenders quite as great, try them for their crimes in the presence of only a few, prohibit by law the sensationalism of the newspapers, prohibit more than the announcement that the trial is on, with perhaps the names of the witnesses, try them before a competent jury, and then at the end of the verdict, if it be "guilty," immolate them at once and forever, or until their crime is expiated. Take the murderer away from public gaze immediately upon his arrest, and we will decrease murder a hundred-fold. When this is done we have removed the horrors to the people of manslaughter under a legal guise, and, as things exist at present, we will have ceased to use the most beneficient of nature's agencies, electricity, in the most repulsive cause known to man.

At a later day we shall beg leave to discuss another phase of this subject, that is the justification for the murder of a hopelessly diseased human being, an incurable lunatic, or a suffering cripple. Radical philanthropists have taken the affirmative of this question, christianity will naturally assume the negative.

NATURE'S LIGHTNING ROD.

M. Oovaroff, the Russian electrician, of Moscow, and Prof. Hischrt, government forest inspector of the same city, have made some investigations concerning the liability to lightning stroke of certain species of trees. In the summers of 1893 and 1894 the two scientists mentioned spent 109 days in the great forests between Moscow and Remereff, and during that time found 597 trees that had recently been struck by lightning. Of the total number of marked trees 302 were found to be white poplar (populus alba), this, notwithstanding the fact that that species is not in any way near as common as a half-dozen or dozen other varieties. On Oovaroff's suggestion the government recommends that the peasants use it as a lightning conductor.—*St. Paul Pioneer Free Press.*

A representative of the Baldwin Locomotive Works, with an expert electrician from the Westinghouse Company, together with Sir Henry Tyler, ex-president of the Grand Trunk Railway, have gone to Peru, where, it is said, a test of the possibility and feasibility of the electric locomotive is to be made upon a railroad 15,000 feet above the sea level.

CHARLES HENRY SUMMERS.

Mr. Summers is the electrician of the Western Union Telegraph Company, and has a justifiable pride in being an "Old Timer." He entered the telegraph service in 1854 as an operator on the old Pittsburg, Cincinnati & Louisville line, of which J. D. Reid was superintendent. Since that time he has been identified with the service, in one capacity or another, and with each successive change of position has gone a step or two higher. In 1867 he was appointed superintendent of telegraph of the Indianapolis, Cincinnati & Lafayette railroad lines, with headquarters at Cincinnati, which position he occupied until 1869, when he was appointed electrician of the central division of the Western Union Telegraph Company, with headquarters at Chicago. During all these years Mr. Summers has seen the telegraph business develop almost from an experiment to an exact science, and from a means of communication between a few important points to a system which reaches to the uttermost parts of the earth. In this wonderful development he has had a part and his long continuance in so important and trying a position as he holds is the best evidence that he has been fully equal to the many emergencies which have presented themselves in an exacting service.

While Mr. Summers is an "Old Timer," he is still "one of the boys," and to the friends who have been allowed to penetrate behind the classic severity of his hirsute ornamentation, there is always an intellectual and occasionally another kind of treat. At all times he is a good friend, a pleasant companion, true and earnest in all his dealings, with a larger circle of friends than usually falls to the lot of men. Long may he wave!

ADVISES STUDYING ELECTRICITY.

At the third annual convention of the Traveling Locomotive Engineers' Association, held in Pittsburg, commencing September 10, President C. B. Conger, of Grand Rapids, Mich., in his opening address said:

"There is some discussion among the men in the operating departments of railroads in regard to the use of electricity as the future motive power, but it does not seem likely that many regular trains will be run by it during the coming year, except on suburban passenger railways. The success of the large motor used by the Baltimore & Ohio, for handling heavy trains through the Baltimore tunnel, shows that these motors can be made to do the heaviest kind of work, while other tests have demonstrated the speed of heavy passenger motors. Such being the state of development it will be well for engineers to acquire a detailed knowledge of the operating of electric motors in all their particulars as we are now skilled in the operation of the steam engine."

The women of Syracuse, N. Y., operated the street cars of that city on September 10 in the cause of charity, and it is said netted nearly $2,000.

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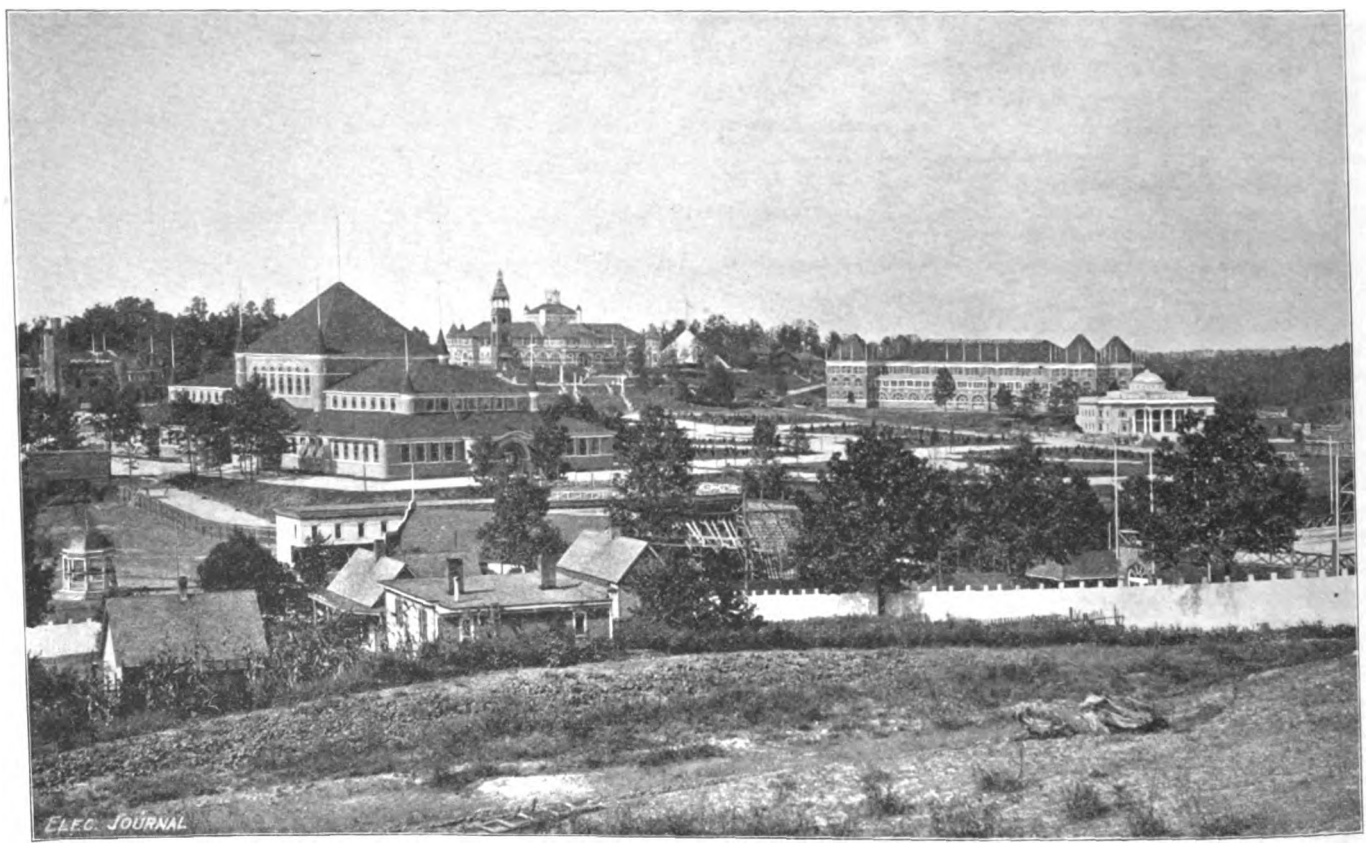
THE ATLANTA EXPOSITION.

Not Quite in Readiness, but will Be Formally Opened Sept. 18—Promises a Good Showing.

The Cotton States and International Exposition will throw open its doors to the world on Wednesday, September 18th. The exhibits are not all in place yet, and it will be some little time before they are, but every effort is being put forth, and it is expected to partially make up for lost time. Unfortunately for the ultimate good of the exposition there is not that frankness with the public on the part of the management that there ought to be. Where it has been possible to get any information at all, the facts have not been squarely put, and the impression has been allowed to go out that much greater progress has been made than is really the case. In the government building things are in pretty good shape, and in one or two others fairly good, but there is much yet to be done before everything is in shipshape and worth seeing.



GENERAL VIEW OF ATLANTA EXPOSITION GROUNDS.

The Electrical department will of course be specially interesting to those who are identified in any form with that rapidly developing science. All the larger firms and many of the smaller ones will be represented, and many new and recent appliances will be exhibited for the first time. The building, which is specially devoted to this purpose, is a structure of handsome design, about 275 feet long and 75 feet wide, and is surmounted by a large dome, similar to that which formed a part of the Illinois building at the World's Fair. The space for exhibits is all on the ground floor, running down either side and across the ends with two central spaces running lengthwise, each 81 x 24 feet in size. There are six entrances to the building.

A pleasing feature of the electrical display will be the great electrical fountain, designed by Luther Stieringer, of New York. Twenty-three powerful electrical projectors of 250,000 candle power will be used and the effect will be both unique and pleasing.

Subscription price to THE ELECTRICAL JOURNAL is two dollars a year. Everybody interested in Electricity should read it.

ASSOCIATION CONVENTION.

Forty-fourth Annual Meeting of the American Association for the Advancement of Science.

The forty-fourth meeting of the American Association for the Advancement of Science was held in Springfield, Mass., August 28 to Sept. 4. The meeting was largely attended and thoroughly successful. A large number of very interesting papers were read in the several departments, including mathematics and astronomy, physics, chemistry, mechanical science and engineering, geology and geography, zoology, botany, anthropology and economic science and statistics.

In the department of physics papers were read by H. S. Carhart on "An Experimental Investigation of the Rotary Field," by Frederick Bedell on "The Method of Reciprocal Points in the Graphical Treatment of Alternating Currents," by John D. Parker on "California Electrical Storms," by C. D. Childs on "Phenomena with Electric Waves Analogous to those of Light with a Diffraction Grating," and by William Hallock on "Electrolytic Reproduction of Resonators."

The next meeting of the association will be held in Buffalo, beginning of the fourth Wednesday of August. The new president for the coming year, is Edward D. Cope, of Philadelphia. F. W. Putnam, of Cambridge, was re-elected permanent secretary; Charles R. Barnes, of Madison, Wis., was elected general secretary, and Asceph Hall, Jr., of Ann Arbor, Mich., secretary of the council.

An important decision was made recently by Judge Bischoff in the Court of Common Pleas of New York, involving the right to recover royalties on patents of the Edison General Electric Company, which the United States Circuit Court has declared invalid. The suit was brought by George Maitland and the General Fixture Company against Henry P. Drew and John May, to recover royalties paid, on the ground that the patents were invalid. The judge said that the licensee of a patent could not recover unless he gave notice of his intention to repudiate the contract before the royalties accrued.

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TELEGRAPHERS' ANNUAL MEETING.

Guests of the New York Electrical Fraternity—Large Attendance of "Old Timers."

The fifteenth annual gathering of the United States Military Telegraph Corps was held in New York City on the 11th, 12th and 13th inst. The Old Time Telegraphers' Association met also at the same time and place. Both associations were the guests of the electrical fraternity of New York, and, as a result, nothing was left undone which could contribute to the success of the meeting.

President Plum's address was somewhat unique in its character. It purported to be a dream which he had had, but which, in reality, was a recapitulation of the history of the services which the telegraphers had rendered the country during the civil war. It described how the members of the telegraph corps had braved the front and fire of battle, how many of them had given up their lives in defense of their country, and how they had been promised the same recognition which other members of the army had received from the government, but which, up to the present time, they had been unable to obtain.

His dream then went on to cite the cases of a number of comrades who had died recently, and who having satisfactorily passed a critical examination on all other points were detained at the gates of Heaven until a record of their services in the army could be examined. It was found that not only was no honorable discharge given them but their names were not even on the army rolls, and so it became necessary to issue subpœnas for witnesses to testify in the matter. When the witnesses appeared there were found among the number, Lincoln and Stanton, Generals Thomas, Grant, Sherman, Sheridan, Burnsides, Banks, Miegs, Logan, McPherson, McClellan, Warren, Franklin, Fremont, Hayes and Stager. They brought with them the quarter-master's rolls, the resolution passed by the Grand Army of the Republic, by the Society of the Army of the Tennessee, and by the Legislature of Ohio: and there were the official orders of Generals Thomas and McPherson authorizing military uniforms, the reports of four committees of the House of Congress and of three committees of the Senate on Military Affairs favorable to recognition of the corps as a part of the army, and the unsigned bill that passed the last congress. Other evidence was offered also, but the "Court of Enquiry" had heard enough: they were satisfied that the telegraphers had served their country well, and finally gave judgment as outlined in the following decree:

"And now this day come Solomon Palmer, Robert B. Lines and Dwight Byington, J W. Hynes, C. F Bort, W. N. Embree, Wiley W. Smith and Benjamin W. Flack, charged with falsely representing themselves to have been members of the Union armies in the late war in the United States, and comes also the attorney general of Heaven, and this cause coming on to be heard upon oral pleading and the proofs on this one point, all others having been determined in their favor, the court finds that the statements made by the accused were substantially true; that the Military Telegraph Corps to which they belonged was in fact an integral part of the army, and that it was of inestimable value to the service, and no corps surpassed, few equaled the telegraph operators in diligence and devotion to their duties; that the society of the Grand Army of the Republic, representing a living membership of over 410,000, has solemnly and emphatically declared that the corps constituted, in fact, a part of the Union army, and partook largely of its hardships and dangers while rendering invaluable aid, and the court further finds from the evidence that the Government of the United States and the people thereof ought to be censured for its and their remissness.

"Wherefore, it is ordered, adjudged and decreed that the defendants have not in anywise misrepresented the facts; that their services were honorable throughout and invaluable as members of the army of the United States in the late war, and they were entitled to honorable discharges from that service; that in all other things as well they have deserved the commendation of 'Well done good and faithful servants,' and are hereby declared to be entitled to 'Enter into the joys of our Lord.' And be it further ordered that the Grand Army of the Republic in Heaven assembled receive them and all of their spiritual comrades into its society, and that those coming, be accorded equal privileges.

"Then the dome of Heaven was rent with acclamations of great joy, and our comrades escorted by a multitude of veterans to the Great White Throne."

A TELEPHONE METER.

A correspondent of an ingenious turn of mind writes, says the Times of Brooklyn, to suggest that there is a chance to introduce a telephone meter, a device by which the use of the telephone may be paid for according to the extent of the service it is called upon to perform. "It doesn't seem fair," says the correspondent, "that all of us should be called upon to pay the same rent for a telephone when some of us use it so much more than others. Among private individuals who pay the same rental for a telephone there is great variation in extent of use. Some are reckless and voluble. Some are cautious and brief. The voluble should be taxed for their volubility, the brief and businesslike be profited by their economy. A telephone meter would fix this at once. With a properly constructed instrument the dial would show the exact number of words transmitted, and the tax could be proportionate."

The suggestion is a valuable one. The injustice of the present system is obvious. The tax is not according to representation. Some people are represented at the telephone every half hour in the twenty-four. They toy with the wire as with a plaything, calling up everybody within range upon any pretext, bewildering the wires, agitating other consumers and shattering the nervous system of the hello girl. This should not be permitted without some due adjustment of the tax. If a man or woman wants to use up electricity with rash prodigality he or she should pay for the privilege.

We do not see why such a telephone meter could not be so constructed as to foster pith and correctness in our language. The register might present syllables instead of words; in fact this might be a mechanical necessity of such an instrument. Thus there would be an inducement to monosyllabic communication. People would get down to business quickly. The busy grocer would hear messages like this: "Hello, Meyers Brothers! Barrel—flour—Jones—60—Jenkins street." Business communications would take on a business form. And even social communications would lose much of unnecessary verbiage. For example, the hello girl would hear Judson and Wilkins exchanging these syllables:

Judson: "Hello! Wilkins."
Wilkins: "Hello!"
Judson: "Anything on—night?"
Wilkins: "No."
Judson: "Come round. Poker; beer: that widow."
Wilkins: "Right."
Judson: "Bye."
Wilkins: "Bye."

Perhaps it would be advisable to construct the meter so that it would be profanity-sensitive, and thus serve a moral purpose by registering double for "damns" and other improper syllables. Undoubtedly this would be as easy to arrange as any other feature of the instrument.

The only trouble with inventive genius is that it does not seem to be as appreciative as it might be of hints like this, and we suppose it may be some time before anybody works the thing out.

It is said on the authority of John D. Crimmins that the Metropolitan Traction Company will within the next five years equip all its lines in New York with the underground electric system in the event that the Lenox Avenue line in operation continues to work successfully during the coming winter season.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students. Personal and Pertinent.

THE LABORATORY COURSE IN CHICAGO.

Arrangements have now been completed for the inauguration of the laboratory course outlined in the last issue. While nothing elaborate may be expected by students, the equipment will include every instrument and appliance necessary for the construction, testing and operation of every variety of commercial apparatus. Provision is made for both direct and alternating current, lathes and lathe tools, benches and bench tools, raw material, etc. The course will adhere closely to the prescribed curriculum of the general course that has been in use by the school, although the work will be very largely of the bench kind. The laboratory quarters will include a lecture room, and didactic lectures with illustrations will be given at intervals during the course.

The laboratory will be open for work from 9 a. m. until 10 p. m. on every day of the week, excepting Saturday and Sunday. The laboratory director will be Mr. Jerome J. Green M. E. (University of Ohio), who will be in attendance continuously.

The work will be largely individual, each student working at his bench as many hours and on the days or evenings that may be convenient for him. The course will require about five months for its completion, allowing for an average number of hours' work per week. Those who work longer hours will complete the course in less time.

The curriculum, which is given below, will be the required course for all students. There will be other optional studies, and students will be encouraged to do research work in various directions, in which they show special interest.

The laboratory class is practically made up, enough having enrolled to make a comfortable class, but accommodations are preparing for a much greater number, so that none of last year's students may be refused admission.

In order to join this class, applicants must have gone through the first year's course of the National School of Electricity, or have studied electricity, either practically or theoretically, in the shop, factory, some school, or in actual practice of some sort, that will be acceptable. The school management will reserve the right to refuse admission to any person excepting last year's students of the school. Those who contemplate taking the course should make application at once, inclosing the initial fee of $10 with their application. The balance of the $25 tuition fee will be payable $5 per month for three months.

CURRICULUM FOR THE LABORATORY COURSE.

1.—Experiments with the Electrophorus.
2.—Experiments with Metal Plates showing Induction.
3.—Experiments with the Leyden Jar.
4.—Study of the Induction or Influence Machine.
5.—Make, Test and Operate Primary Batteries and give complete report of same.
6.—Make Plante Cell and report on same.
7.—Experiments in Magnetism:
  a—Make Permanent Magnet from Bar Steel.
  b—Make and Mount Compass Needles—Oersted's Experiment.
  c—Map Lines of Force.
8.—Demonstrate Ohm's Law.
9.—Ohm's Law in Experiments with Divided Circuits.
10.—The Standardization of Ammeter by Copper Deposit.
11.—Law of the Galvanometer.
12.—Measurement of Ohmic Resistance:
  a—By Substitution.
  b—By Divided Wire Bridge.
  c—By Wheatstone's Bridge.
  d—By Differential Galvanometer.
13.—Measurement of Specific Resistance and Conductivity of Various Metals.
14.—Internal Resistance of Batteries.
  a—By Mance's Method.
  b—By Opposition.
  c—With Variable Resistance in Series.
  d—With Variable Shunt.
  e—By Compensation.
15.—Comparison of Electro Motive Forces:
  a—By Addition and Subtraction.
  b—By Voltmeter.
  c—By Equal Deflections of Galvanometer.
  d—By Compensation.
  e—By Condensers.
16.—Condensers and the Measurement of Capacity:
  a—By Direct Deflection of Ballistic Galvanometer.
  b—By Division of Charge.
  c—By Bridge Method.
17.—Experiments Showing Leakage and Absorption of Condensers.
18.—Electroplating Work.
19.—Construction and Operation of Complete Telegraph Circuit.
20.—Construction and Operation of Complete Telephone Circuit.
21.—Insulation Resistance:
  a—Method by Direct Deflection.
  b—Method by Substitution.
  c—Measurement of Resistance of Wood, Wet and Dry.
  d—Measurement of Various Forms of Glass, Porcelain and Other Commercial Insulators.
22.—Calibration of Ordinary Voltmeter:
  a—By Standard Cell.
  b—By Comparison with Standard Voltmeter.
23.—Winding of Continuous Current Armatures.
24.—Measurement of Armature Resistances.
25.—Measurement of Magnetic Leakage of Dynamo or Motor.
26.—Study of Direct Current Generator:
  a—Magnetization Curve.
  b—Characteristic Curve.
  c—Plotting Curve from Readings on Speed and e. m. f. of Dynamo.
  d—Curves of Series Dynamo.
27.—Test for Regulation of Motor.
28.—Measurement of Foucault Currents and Hysteresis.
29.—Complete Efficiency Test of Dynamo or Motor.
30.—Photometry.
  a—Test of Incandescent Lamps for Candle Power and Current Giving Efficiency.
  b—Test of Arc Lamp.
  c—Investigation of Absorption and Reflection of Light by Globes and Screens.
31.—Temperature Coefficients of Copper and Carbon.
32.—The Measurement of Copper Plating on a Carbon Rod and Its Effect on Resistance.
33.—The Location of Leaks and Faults on Lines.
  a—An Incandescent Circuit.
  b—An Arc Circuit.
  c—On Telegraph and Telephone Circuits.
34.—Experiments with Electro-magnetic Induction:
  a—Winding and Testing of Induction Coils for Telephone and Medical Purposes.
  b—Winding and Testing of Transformers.
  c—Winding Armature for Alternating Currents.
  d—Changing Commutation of Continuous Current Dynamo so that it will give an Alternating Current.
  e—Readings of Instantaneous Values of Current and e. m. f. to plot Alternate Current Curve.
35.—Testing of Fuse Wire and Other Special Material.

SCHOLARSHIP AWARDS.

It has been decided by the school management that the scholarship with which students who distinguish themselves, will be rewarded, shall be a complete laboratory course in the Chicago laboratory of the school. It had been the intention to give students the option to attend any one of the colleges or universities under the scholarship provision of the school, but it has recently developed that nearly, if not all, of our students would be barred from this privilege by their inability to pass the rigid entrance examinations. Moreover, it has been ascertained that the very reasons which have prevented our students from taking advantage of college facilities heretofore would prevail at this time. It is contemplated that other laboratories will be opened in other cities in the near future, so that all students may have the same privileges that the Chicago men have.

Charless Barnett, a member of the Terre Haute, Ind., class of the national school, died August 21 after an illness of several months. His remains were taken to Logansport for interment. Mr. Barnett was an employee in the Vandalia machine shops and was much respected both by his associates in the shops and by his fellow members in the school.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

The United States has taken an appeal in the Bell Telephone case involving the validity of the Berliner patent.

Telephone service is the cheapest form of communication in existence. Basing calculations on an annual rental of $72, the service only costs between one and two cents per message.

The Harrison Telephone company has surrendered its franchises in Terre Haute, Fort Wayne, Anderson, Richmond, and other cities of Indiana, thus leaving the field clear to the Bell company.

The Czar of Russia has endorsed electric traction. So we may consider the whole matter settled. The Czar's consent is all that has stood in the way of electric traction in this country, so we may now build a mile or two of road.

The following order has been issued by the Chicago Telephone company: Operators will not be permitted to report at this building at any hour of the day or night in bloomer costume, nor to assume that attire before departing for home.

The Chicago Telephone Company propose to make all its public telephones of the automatic kind. It will then be necessary to deposit the necessary fee before connection can be had with subscribers.

The Chicago Board of Trade is to be equipped with telephones for the use of members. Instead of the regulation bell signals, colored lights will be used. But it is probably untrue, as urged, that board members are preparing to open up side bets on the color of the lights, as they flash.

Twelve telephones have been put in on the floor of the Chicago Board of Trade. These will take the place of messenger boys formerly employed to carry messages between the Board rooms and the offices of the members; each talker will be inclosed in a metal frame so that his neighbor can neither hear nor see what he is doing. There will be no bells, but there will be colored lights similar to the express 'phones. The office calls up by simply taking the receiver from the 'phone. A light will flash on the floor of a board, and a much larger colored light will show the numbers much higner up on the wall, so that the dealer in the pit can see the number and rush for the 'phone. If this plan of receiving and delivering orders meets with favor among the members, many more instruments will be put in.

Light and Power.

Omaha during State Fair week will make a brilliant display of electric lighting.

The street railway between Owosso and Corunna, Mich., which has heretofore been operated by steam, has been purchased by Alexander Ralph, of Philadelphia, and will be equipped for an electric line.

Upon completion of the present arrangements being made by Fresno, Cal., for a supply of electric power from the San Joaquin, they will paint a hectic flush upon the sky in the celebration of the event.

There is a possibility of electricity being used by the Grand Trunk Railway as motive power for their tunnel under the St. Clair river at Port Huron. They are led to this action by the effect of the steam engines upon the tunnel structure.

The Carmelite fathers, on the Canadian side, are the first to avail themselves of the Niagara power for heating purposes, they having awarded a contract to heat their new monastery by electricity to a local company, the Niagara Falls Park and River railway to furnish the current.

The Niagara Falls Power Company has refused to accept the power franchise which the city of Buffalo offers it. It objects to the imposition of a 5 per cent tax on the gross receipts, to the clause which provides for the burying of the wires on call by the city, to the limiting of the franchise to 25 years instead of 36 or over, and to the proviso that the council shall have the right to revoke and annul the franchise on 10 days' notice for any alleged violation or failure to comply with the provisions of the ordinance.

Prof. Palaz, says the London Engineer, gives a table of comparative heat in the different forms of lighting. The figures quoted are relative to a given quantity of light: Arc light, 4; incandescent light, 14; kerosene, argand burner, 331; gas, argand burner, 380; candle, 473; gas, butterfly burner, 511. The heat question is a very important one, but it is as nothing compared with the question of vitiated atmosphere. In this respect, of course, electricity compares still more favorably with all other sources of artificial light.

Eva Weinsten, a 19-months-old child, was killed by the electric cars on Canton avenue in Toledo, Sept 12, and an infuriated crowd nearly succeeded in lynching Motormon Leclider in consequence. The child ran across the track with such suddenness that it was impossible to stop the car. A number of killings have occurred on the avenue. A crowd gathered in an instant, and the motorman only escaped death by running from the scene with all the speed possible. A squad of police was hurried to the spot, giving much needed protection to the conductor. It was fully half an hour before the crowd could be opened up to allow the street cars to run again.

A novel effect will be obtained by electric lighting at a fair to be held in Hartford, Conn., October 5-14. An artificial sky will be constructed all over the spacious armory, in which the fair will be held, as though the show was being given under the blue vaulted canopy of heaven. The artificial sky will be made of blue bunting and behind this, to make the illusion complete, will be electric lamps of varying size and power, placed in such way as to represent stars which will twinkle as in the night. Larger lamps will represent the planets and there will be lamps of three or four candle power, the stars of lesser magnitude. The whole sky will be dotted with stars representing the various astronomical forms and phenomena. There are two principles involved in the plan which has been adopted: First, to have the lower part of the open space and booths brilliantly lighted; second, to keep the upper part comparatively dark, representing the sky at night with small and large lamps scattered to represent stars and planets. Specially designed reflecting shades will be used to produce the desired effect, and the small lights representing stars will be arranged with a communicating switch run by an electric motor in such a way as to cause them to twinkle automatically at regular intervals. There will be from 120 to 140 lamps to produce the sky effect. All the clusters of lamps for general lighting will be fitted with white opal shades.

Railways.

It is said that the Baltimore & Ohio railroad has determined on a reduction of 25 per cent in suburban passenger rates in several cities, with a view to meeting competition by electric lines.

The Board of Trade of Cincinnati has ordered an investigation of the underground electric railway system of New York, with a view to urging its adoption in Cincinnati if the report shall be favorable.

Work on the Buffalo & Niagara Falls Electric Railway between Buffalo and Niagara is progressing rapidly and will soon be completed. A large sum of money has been expended in making it a first-class line; it will be equipped with magnificent cars having air brake attachment and 25 H. P. motors.

A director of the Metropolitan Traction Company speaking of the saving in expense of operation by electricity by the underground system, which is admittedly more costly than the overhead trolley, said that as compared with cable traction it is 4 cents per car mile cheaper, and as compared with horse traction 8 cents per mile cheaper. He figured that the saving to the company when all their lines should be electrically operated would be about $2,000,000 a year.

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The three great street railway companies of Philadelphia, now consolidated into one, carried during the year ending June, 1895, the grand total of 58,125,481, an increase of 17,085,133, or equal to 41.6 per cent. The increase is attributable largely to the use of electricity as a motive power.

By way of demonstrating, in a practical way, that steam is not prepared to give up the fight for supremacy without a protest, it may be noted that in England a few days ago a steam engine made 540 miles at the rate of a mile a minute. The New York Central a few days ago made a record of 436½ miles in 407 minutes. These are sufficiently good records to rest on for a short time at least.

The government of Norway owns and operates nearly all its lines of railway, but is unfortunate in having no coal mines in the country to draw upon for steam purposes. In view of this fact, and the abundant supply of natural water power which it possesses, there exists a special interest in the application of that means of obtaining electric power to operate its railway lines. The government has sent a representative to this country to investigate the developments which have been made in long distance transmission of electric power, and hopes to find a means of utilizing it in its railway service.

General News.

Hilton, Hughes & Co, the large retail dry goods firm of New York, is using an automobile vehicle operator by rectified petroleum possessing a density of 700°. From the combination of air and oil a steam is obtained which is stored in a cylinder through which a current of electricity is conducted, causing a rapid succession of explosions and creating a force which serve to operate the vehicle. The cost is said to be one cent a mile, and enough oil can be carried to last for five days of ten hours each. A speed of from fifteen to twenty miles an hour is claimed.

An invention has appeared which would seem to make possible the plan, rejected as impracticable by the Marine Congress at Washington, to establish ocean paths for all vessels. The invention consists of an electric steering indicator, and its introduction promises to have considerable influence on the art of navigation. The apparatus indicates constantly in all weathers the longitude, latitude and course of a vessel at sea, makes its own correction for compass vibrations. If this invention should fulfill its promise one of its direct results will be that the trip of a fast steamer between New York and Liverpool will be shortened five or even ten hours, from the possibility of maintaining the absolutely straight course.

A Chicago man has commenced a fight in the circuit court against the telephone company of that city to test their right to erect poles upon Lake avenue in Hyde Park where he lives. Mr. White asks the court to enjoin the telephone company from maintaining poles and telephone wires as well as conduit pipes in front of his house, which is situated south of 39th street. The complainant says his property is improved with a fine house, having a frontage upon the avenue, and that the wires and tree trunks which the company have erected are a nuisance in front of his house. White adds that the wires constantly give out "disagreeable noises," particularly in cold weather, disturbing his peace and quiet and that of his family.

The Copenhagen correspondent of the London Electrician reports a terrific thunderstorm with unprecedented effects, which passed over a portion of Northern Jutland during the night between Thursday, August 22d, and Friday, August 23d, causing the loss of several lives, over 50 fires, and the destruction of a great many horses and cattle in the fields. The storm came from the North sea, and the principal sufferers were the small towns and villages on both sides of Limfjord. At Thisted, 52 violent flashes were counted within two minutes; the lightning struck incessantly, and the inhabitants rushed out from their houses, although it was pouring with rain at the time. From Aalborg 12 fires could be observed, and a postman, driving from Thisted to Aalborg, saw 26 fires en route. At Saby the telephone suffered severely. The loss of property was very serious.

STATIONARY ENGINEERS' CONVENTION.

The annual meeting of the National Association of Stationary Engineers, held at St. Paul, Sept. 3, 4, 5 and 6, was well attended, and in every respect a successful gathering. In addition to other business of importance a new constitution and by-laws were adopted. These provide that hereafter the annual meetings of the convention shall be held within a radius of 200 miles of Cleveland. For the next convention Buffalo was selected. The educational work of subordinate associations was commended, and further effort in that direction was urged as likely to be productive of good results. The election of officers for the ensuing year resulted in quite a spirited contest, Mr. C. H. Garlick, of Pittsburg, being chosen president, and "Jimmy" Edwards, of No. 1 of Chicago, secretary.

A COMMENDABLE PLAN OF CLASS WORK.

The Kansas City class of the National School of Electricity has in its membership several electricians occupying positions which give them good opportunities for study in special lines. It is the policy of the instructor of this class to utilize, as far as possible, this talent for the benefit of the class. Among those who are qualified to give such assistance is Mr. N. D. Ballantine, of the telegraph department of the Kansas City and Ft. Scott railroad. At the last class meeting—Lesson XX—Mr. Ballantine was invited to give an explanation of some of the more common methods of multiple telegraphy in practical use; this he did in a very effective and pleasing manner. Mr. Ballantine supplemented his talk with an exhibition of instruments, which he brought from the laboratory of the company by which he is employed. In addition to the instruments illustrated on the lesson leaf, the instruments for phonoplex telegraphy were shown and explained. The phonoplex is a system which operates by induction, when alternating, pulsatory currents set up by the "makes and breaks" of the ordinary current are superposed on it.

It is a principal in good teaching never to tell the class a thing which could be as well or better told by some member of the class, who may have had special opportunity of knowledge on the particular topic in hand; this gives encouragement to the able and painstaking, and furnishes an incentive to the other members of the class; besides, it better qualifies the instructor for his work by putting him in touch with practical people.

PUBLICATION NOTES.

The Revue General Des Sciences for July 30 contains articles on "New Ideas in Color Photography," by M. B. Brunhes; "Recent Progress in Steam Engines," by M. A. Witz; "Liquefaction of Hydrogen, Determination of the Critical Temperature and Boiling Point of Hydrogen," by M. E. Methias; "Annual Review of Geography," by M. N. Deherain, and a description of an apparatus, similar to the Edison kinetoscope, except that it projects the rapidly changing views on a screen, by M. A. Gray. The issue of August 15 contains a series of articles on Madagascar by M. E. Caustier, M. A. Milne Edwards, Dr. A. De Faymoreau, M. L. Suberbie, M. G. Foucart and Dr. R. LaCaze.

MOTOCYCLE COMPETITION.

The Chicago Times-Herald announces fifty-five entries for their horseless carriage contest to take place on Nov. 2. Competitors will come from all parts of the country and all kinds of vehicles will be represented. Considering the short time since the contest was first announced, the large list of entries goes to show very conclusively that the question of propelling road carriages by other than horse power has been engaging the attention of practical men for some time and it is expected that a satisfactory type of vehicle will be the outcome.

SITUATION WANTED.

YOUNG MAN—GRADUATE OF EUROPEAN TECHNICAL School, wishes position in some electrical business where capacity and intelligence will be appreciated. Willing to pay for such position. Reply M. A. BROWN, 4442 Langley avenue, Chicago.

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ELEMENTARY PRINCIPLES OF ELECTRICITY.

A Line of Thought Essentially Different from that Commonly Employed in Teaching.

While the subject of electricity is involved and essentially difficult to the beginner, every one realizes that the common method of introducing it is very unsatisfactory. The following outline of a plan is given with the hope that it may help those who have not yet mastered the fundamental concepts of the science, and that it may receive some consideration from those who, like the writer, have often been painfully aware of the presence of a fog about the minds of their pupils after a few lessons devoted to "attraction" and "repulsion," and "positive" and "negative" electricity.

That one instructor thinks he has been fairly successful with his own method does not prove much, and I would suggest the plan with much diffidence were it not that I am only urging the immediate unfolding to the beginner of conceptions that usually come only to the student of many months' standing, and that experience persuades me they can be in a manner comprehended.

I proceed on the assumption that our object is to get a working and yet scientific knowledge of the subject in the least possible time. Yet, where more time is at hand, slight modifications make the plan available for presenting static electricity as a mental discipline, and at the same time as one of the finest illustrations of modern physical method.

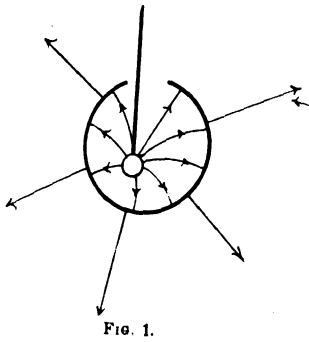

Fig. 1.
Charged Ball in Insulated Shell.

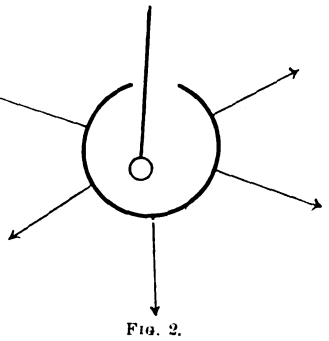

Fig. 2.
Same After Contact.

In justification of beginning with the substance-theory of electricity, I have only to say that it appears more reasonable to begin with it, provided we can make it intelligible, than to begin with words, for the most part, and ending with the Franklin-Maxwell theory. That highly trained minds do not need Maxwell's theory, and perhaps do not believe it, is not to the point if it is the highest conception that the great body of electricians can rise to, especially since it is at the bottom of all our electrical terms and affords (at least some notion of) what the mind is seldom satisfied without, viz.: the mechanics of the thing. As usually presented, static electricity has no meaning to the beginner in current electricity. By the following method *every* idea presented in even a brief course in static can be made immediately available in dynamic electricity; and certainly, by this time, some method ought to be forthcoming which would make this possible.

If we understand the nature of energy at all there must be throughout all space a something which possesses inertia, but which perhaps has no weight because it is not atomic in structure. Of its make up we can form no intelligible notion: we call it ether—the ether—and suppose that a constituent part of its composition is the substance we call electricity. We must consider that electricity tends toward uniform distribution, it cannot move through void space, but in the presence of gross matter can move more or less freely (we might say, from anything we know, more or less rapidly). Conductors and non-conductors are relative terms.

If a dry glass rod is rubbed with silk certain phenomena can be made to appear that are best explained, everything considered, by assuming that, in some way, the rubbing has left the rod with either an excess or deficiency of electricity. There is no way of knowing which, so either will do; and for a starter, Franklin guessed *too much*, and all electrical science has been built up, and our terms coined, on that hypothesis. It is "positively" excited; it has more electricity than its share. If, as we have said, electricity tends to distribute itself uniformly, it will try to leave the rod and, we may say for the present, divide up with any material thing in the neighborhood. If we hold near the rod an insulated pithball pendulum, the rising of the ball to meet the rod and its clinging to it suggest the idea of its drawing the ball and soaking it with electricity. Shortly the ball leaves the rod, and if held anywhere throughout the "field" the inclination of the thread from the vertical shows that it is pulling the hand away. If we move the hand toward the rod, the greater inclination shows that the force is greater. The essential points here are the supposition that the ball and rod have more than their modicum of electricity, and the fact that we have to *do work* on the ball, or its electricity, to get it closer to the rod; and the closer we bring it the more work we have to do to move it up a given distance, say one centimeter. Because we have to do work on a quantity of electricity to bring it closer to the rod, or because the electricity will do work in order to get away, we say the rod possesses electrical *potential*. We also say, consistently, that any point in the region of the rod possesses potential by virtue of the presence of the rod, because we have to *do work* to get the electricity to that point from a point radically more distant. We also say that two points 9 and 10 c. m. away have greater *difference* of potential than two points 19 and 20 c. m distant, and this difference diminishes as we move the rod. In all this the notion of *repulsion* continually intrudes itself. We may best rid ourselves of it, for the present, (but we will not need it at any time) by substituting another. Why does the ball leave the rod? Why does a stone roll down hill? Because the summit or sky repels the stone? We say, because the earth attracts it. Let us rather say the stone rolls down because we would have to *do work* on it to get it back, or because it can do work by rolling down. That is the reason your watch runs down, or the fire burns, or hot bodies cool, or anything else happens that does happen on this globe of ours, except what is due to the sun's rays. In fact, Nature acts as if she were determined to get rid of her sum-total capacity for doing work as quickly as possible. Or, without being so personal about it, we may say: if any system of two or more bodies can by any motion, however slight, assume a form from which it cannot recover, unless work is done upon it by an outside agency, that motion *will take place*. The electricity in or on the ball, then, leaves the rod because it can do work by so doing; and this is the reason for our name potential, as applied to the rod (Lat. *potens*, having power). Now, if we run the hand along the rod and roll the ball between the fingers, we can reproduce none of the previous phenomena, and we say we have let the electricity on the rod and ball equalize with our bodies, the house and the earth and the "excess," if any remains, is inappreciable.

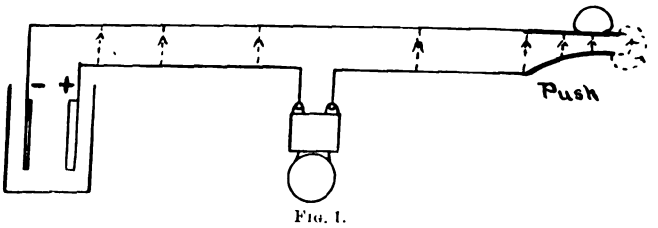

Fig. 1.
Bell Circuit.

Beginning again with two pith balls hung 1 c. m. apart, and letting them touch the rod, if they get equal quantities of excess we may arrive at the notion of *unit* quantity if the element of the size of the ball be eliminated, and we imagine a spring balance of no weight to register 1 dyne when holding them 1 c. m. apart against the force tending to separate them. Now, one of these balls may be held just far enough from the other, in any direction you please, so that it requires us to an erg of work to

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bring it 1 c. m. towards the other; in which case we say that *unit difference of potential* exists between its first and second positions. If we rub the rod more briskly we may assume that there is more excess of electricity per square unit of its surface than before, and that if we touch it to one of the balls, the ball will have more than before. We find by trial with this ball and the other that its potential has been raised by increasing its "charge," and it would not be wrong to jump to the conclusion that if we have doubled the charge we have doubled its potential if the rod is not in the "field." That is, other things the same, potential varies as the charge.

If the ball has potential, the question is, how much? It has two, three or twenty times whatever unit we choose. Since the expression, "the ball has potential," was chosen because of the work involved, we may define the potential in terms of the *amount* of work if only we agree on a starting point and incorporate our unit of quantity. It is a poor analogy, but better than none, to say that just as we may change the level of water in a tub, but cannot change the ocean level, so we may change the potential of small bodies by varying their charges, but no quantity of electricity we could manipulate would change the potential of the earth. Hence, how much work it takes to bring unit quantity of electricity from the earth to a body depends only on the potential of the body, if no other body having potential is "in the field." Thus, then, we may define unit potential (so called "absolute," referred to the earth), as that potential that involves one erg of work in the transfer of one unit of electricity from the earth to the body.

It is not difficult to see that any conductor through which no electricity is flowing is everywhere at the same potential, and conversely, if two points of a linear conductor differ in potential a current is flowing between them. Then any "grounded" conductor carrying no current has the same potential as the earth which by above definition is *zero*. "Discharging" the apparatus, we touch one ball to the rod after re-exciting it. Holding it a certain distance from the other we note the force as shown by the deviation of the threads from the vertical. Now, we touch to the second ball a piece of sealing wax that we have rubbed with flannel. On presenting one ball to the other, at same distance, we perceive much greater attractive force; hence the difference of potential must be greater than before. Now before No. 2 touched the wax its potential was that of the earth, and No. 1 has not been touched or changed. We must conclude that No. 2 now has a potential less than that of the earth and that, following our previous reasoning, it has less than its *quotum* of electricity. So there is a potential less than that of the earth. As we know of no limit in either direction, if we want a starting point, we must go both ways from the potential of the earth which we must, then, call zero potential, and all others positive or negative. However, positive and negative potential are relative terms, and only occasionally used with reference to the earth for convenience. It is of vital importance to understand that any point whose potential is higher than that of another, may be lower in potential than a third, and it is entirely right to say its potential is either positive or negative, as we refer to one or the other of the two points; and that the terms positive and negative *as commonly used* have to be followed up by: "with reference to" the point whose potential is for the moment taken as a basis. Note carefully also that one point has "higher" potential than another if it requires work to take the pith ball that has touched the excited glass rod from the latter to the former.

If we watch the attraction between two balls that have touched the glass and wax, respectively, we are very wise or else very simple if many puzzling questions do not come up: and a little study of one or two of them, with the aid of authorities in order to save time, will materially help us in the future.

We are as certain as we care to be of anything that there must be some kind of strain in the ether between the two balls; for these experiments work in a vacuum, and one could not *do work* on the other without such strain, any more than we could "draw up a chair" without touching it or using a stick, string or other material thing.

Those who have considered these phenomena most carefully and successfully have taught us that we can explain all we have seen or will see by referring the actions to material strains called "lines of force" that have the following properties:

(*a*.) Every charged surface * is met by lines of force; and conversely.

(*b*.) Lines of force start from a surface of given potential and end on one of less.

(*c*.) They tend (1) to shorten indefinitely, and (2) to repel one another.

(*d*.) They meet any surface at right angles.

From this out it matters little which of two plans we pursue. We may perform experiments to prove the truth and sufficiency of these suppositions, or we may assume their adequacy and produce *a priori*, the condition of electric equilibrium in given cases. The latter is better, for we must try every case experimentally to be sure we have not made a slip in our reasoning, and in that way we can incidentally verify our assumption of properties.

Constructing diagrams will materially help us, for we can represent these strains in the ether by lines, arrows on them representing which way they "run." By the number of lines meeting a given surface we may denote the amount of the charge, positive or negative, that is on or in the body.

The last clause suggests a problem to start with. Which shall we say, *in* or *on* the body? If a non-conductor has received a charge, of course the electricity is not inside, for it could not get there. To find how it is in case of a conductor imagine an insulated, charged brass shell. It is everywhere at the same potential, necessarily. Hence no line of force can leave one point of the shell and end on another (by *b*), but no line of force can leave the inner surface and escape; as the inner surface is not met by lines of force it has no charge (by *a*). This can be proved by experiment. The "law" is: There is no charge in equilibrium on the inner surface of a hollow conductor that cntains no insulated charge, nor is there a charge within the material of any conductor.

The foregoing, necessarily brief outline, suggests a method of introducing the subject that is, I think, scientific intelligible, consistent throughout and economical of time. Filling in and extending the notions to capacity, density, induction, charging by induction, machines, etc., requires care only to avoid dropping into the usual methods and phrases.

To be sure an expert leader with sufficient time at his disposal *can finally* get his pupils out of the woods that the old method necessarily plunges them into. It is just as certain that the *actual result* with the average teacher and average pupil has so far been a wretched failure.

I once asked an E. E. who commands a high salary as an expert, in what respect the condition of an electric bell circuit differs before and after connecting in the battery. He said: "In no respect; nothing in the wire till the button is pushed." On being asked how the battery "knows the circuit has been closed," he reflected awhile and gave it up. The question is simple, but its answer must be technical. A battery is a device for maintaining a difference of potential, and Fig. 3 answers the question and shows how easily we pass from static to dynamic electricity.

If the above method is faulty, what is the matter with it? If at any point it is obscure or apparently inconsistent, the reader will please blame the writer, if he can, who in turn points to the necessary brevity of the discussion.

[In Fig. 1 the arrows *from* the shell denote "lines of force" to the walls of the room. In the second figure the ball has the same potential with reference to the earth that it has in the first. The shell has potential in the first, but not so much as in the second case, where its potential equals that of the ball. These two figures suggest the usual proof of the above "law." Possibly the longer proof is more rigid.]

* A "charged" surface, positively or negatively, may be defined as one which contains either more or less electricity than it would contain if connected with the earth in a region remote from any body whose potential differed from that of the earth.

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SIR HUMPHREY DAVY.

Eminent Natural Philosopher. Born at Penzance, Cornwall, in 1778. Died at Geneva, 1829. Discovered, in 1802, the Electric Arc between two Carbon Electrodes.

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The Electrical Journal.

Vol. 1. CHICAGO, OCTOBER 1, 1895. No. 9

THE SCIENCE OF PHOTOMETRY.*

The Harcourt Pentane Portable Lamp, the Best for Purposes of Measurement—Descriptions of German and French Devices.

A UNIVERSAL STANDARD URGENTLY NEEDED.

The standard of light which has been preferred by most photometrists in France is the Carcel lamp. It is a special form of Argand lamp, devised by M. Carcel, in 1800. It burns refined colza oil, which is kept at a constant level about the wick by a small pump driven by clock work. The light it produces is equal to about nine and one-half times that of the standard sperm candle. The obtaining of even fairly good results with it requires the greatest care. A new wick must be inserted each day the lamp is used. The wick must be very carefully trimmed, and its heigth above the wick tube accurately adjusted, and also the rate at which the oil is burned. The amount of light produced by the lamp varies seriously with the quality of the oil and with the fineness of the wick.† For these reasons, the Carcel lamp must be considered no better than the sperm candle as a standard, and it has been but little used outside of France.

GERMAN STANDARDS.

In 1868, the German Association of Gas and Water Industries adopted as a standard a candle made of paraffine. Its composition, size and rate of burning are all carefully specified. Another form of candle known as the Munich candle is specified as standard in the contract between the city of Munich and the gas company. This is a stearine candle, made in a definite way. Both these candles have been largely used as standards in Germany, but critical comparisons between them and sperm candles by Germans, show no decided advantage over the performance of sperm candles.

A later form of German standard is the Amyl-Acetate lamp. It was designed by von Hefner-Alteneck, of Berlin. It is a form of spirit lamp. The wick tube is of German silver, 25 min. high, 8 min. inside diameter, and 8.3 min. outside diameter (25.4 min. = 1 inch). It is provided with a guage, by the aid of which the flame is carefully adjusted to its proper heigth, 40 min. Figues 1 and 2 (from Palaz Phototometry) illustrate the construction of the lamp.

The combustible used is the acetate of Amyl, the "fear oil" of commerce. Its boiling point is 138° Centigrade. Its odor is like that of the banana. It is easily obtained in sufficient purity, or may be readily prepared by distilling acetic acid with sulphuric acid and amylic alcohol. The wick consists of a sufficient number of straight cotton threads to fill the wick tube without crowding.

The performance of this lamp has been exhaustively studied in Germany. It has been found to be quite constant. Liebenthal found that the mean error of one observation varied between 0.5 and 1.5 per cent. Dibdin (in England) found that in 206 out of 225 observations the readings differed less than 1 per cent from the average of all. Such impurities in that combustible as can not be readily detected and avoided have little influence on the light produced. Small variations in the heigth of the flame are comparatively unimportant, and can be readily corrected. A committee of the German Association of Gas Engineers found on comparison that the light produced by the lamp is .886 of that produced by a sperm candle.

While the variations in the light given by a single amyl-acetate lamp are small, the amount of light given by different

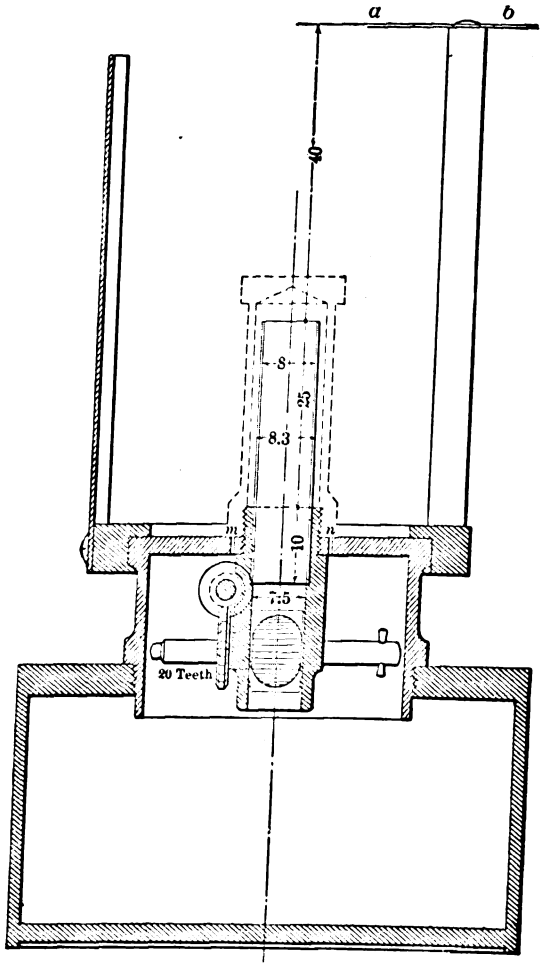

FIG. 1
HEFNER LAMP.

lamps, made by the same maker or by different makers, has been found to be different to a serious degree. The committee alluded to above compared six of these standards, with a similar lamp, the standard of the Reichanstalt (the Physico-Technical Institute at Berlin, which is the official standardizing Bureau in Germany) and found the following values, 0.987, 0.993, 0.993, 0.965, 1.016, 0.981, a range of 5.1 per cent. Another set of such lamps has been found to show a difference of 12.1

*Continued from August 15.
†For a detailed account of this lamp see Palaz "Industrial Photometry," page 111.

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per cent. in intensity. Palaz justly says, "Under these conditions it is difficult to adopt the Hefner lamp as an absolute standard when one of the principal advantages claimed in its favor, the facility of identical reproduction, does not exist."

This standard has been adopted by the German Society of Gas Engineers, and is the standard in use at the Reichanstalt. Its adoption by the Chamber of Delegates at the International Electrical Congress, at Chicago, in 1893, was strenuously, but unsuccessfully urged by the German delegates. Provision is made at the Reichanstalt for testing these lamps, and official

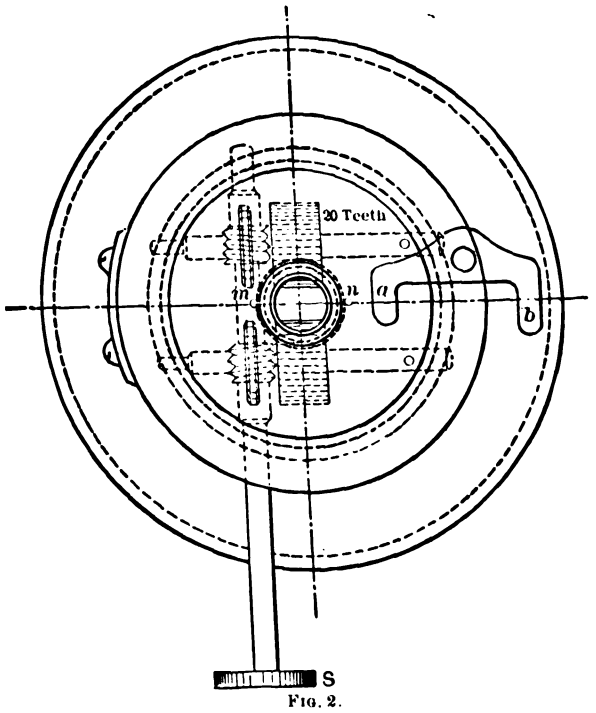

Fig. 2.
HEFNER LAMP.

certificates are given them, provided their structure and performance do not vary more than specified amounts from the values prescribed.

The advantages of the amyl-acetate lamp as a standard are its portability, constancy, and ease of manipulation. Its disadvantages are its low value, its color, and its sensitiveness to air currents. Its color is somewhat red, making its use difficult with strong gas or oil lamps, and still more so with incandescent or arc lights. Notwithstanding these disadvantages, the lamp has many strong advocates, and may be of service in the gas industries. It is not likely to be adopted as a standard outside of Germany. Palaz Photometry gives a full description of the lamp, and accounts of the study of its performance. An appendix gives the Reichanstalt regulations for testing it.

PROPOPOSED ENGLISH SUBSTITUTES FOR CANDLES.

In England several substitutes for candles have been proposed, those most used up to the present being the Methven screen and the Harcourt pentane lamp. The Methven screen is shown in Fig. 3.

It consists of a London Argand gas burner of the 16-candle size, in front of which a brass plate is mounted as a screen: Over an aperture in the plate, a thin silver plate is placed, in which is a slot about one inch high and one-quarter of an inch wide. This slot is carefully adjusted to allow an amount of light, equal to that emitted by two standard sperm candles, to pass from the white central part of the gas flame. The flow of gas is adjusted until the top of the flame is at the level of two wires attached to the screen.

This standard is much less affected by variations in the quality of the material burned, than any of the standards in which the entire flame is exposed to the photometer. In order to still further diminish such variations, Methven adapted a "carburetter," or box containing gauze screens kept wet by pentane, a special gasoline. The gas to be burned is passed through the carburetter and becomes saturated with the vapor of the volatile pentane. Used in this way Methven claims that the candle power of the screen is the same with the gas ranging between 10 and 20 candle power, a statement which the writer cannot confirm. A second silver slot, shorter and broader, is used with carburetted gas, and the height of flame is adjusted by a second pair of wires about half an inch lower than those used with plain gas.

The Methven screen is quite convenient in use, and gives fairly good results when properly handled. Its color is whiter and better than that of candles. It has been more largely used in this country than any other substitute for candles. It cannot however be considered as an absolute standard. Each screen must be tested by comparison with some other light taken as a standard, as in the case of the amyl-acetate lamp, to find out what its true intensity is. It seems likely that this will eventually be found the only safe method to follow with any form of standard, as has already been found necessary in the case of standards of length and mass.

The Harcourt pentane standard is made in three forms. In the first two it consists of a simple open tube burner with no wick, through which a gas passes and is burned as an open flame 2½ inches high. The gas is a mixture of air and pentane vapor, 20 volumes of air to 7 volumes of vapor. These are laboratory forms and may be passed without further description. The third or portable form is shown in Fig. 4.

It is a spirit lamp having a long and massive wick tube. The round wick, about one-quarter of an inch thick, carries pentane up to about one inch from the top of the tube, where the heat of the tube vaporizes it, and it passes on to the flame at the top of the tube. The wick is thus not burned. Outside

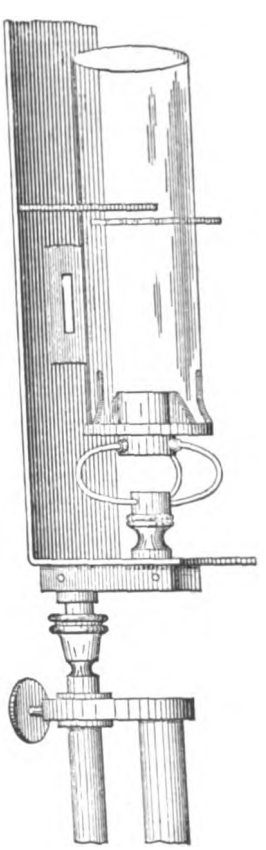

Fig. 3.
METHVEN SCREEN.

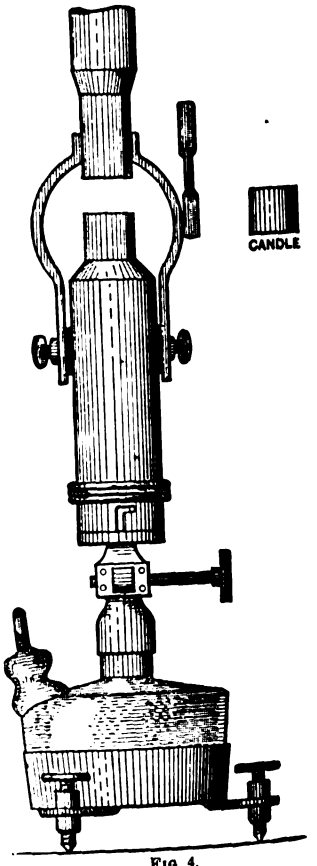

Fig. 4.
PENTANE LAMP (INDUSTRIAL MODEL).

of the wick tube is a second larger tube, between which and the wick tube air is supplied to the flame. The air is heated thus and produces a whiter flame than would be otherwise possible. A metal chimney is carried over the flame, by forked metal supports attached to the outer tube below. A space is left between the bottom of the chimney and the top of

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the tube below, and it is only the part of the flame which is in this opening, that emits light to the photometer. The heigth of the opening may be adjusted by means of guages so as to allow light to pass equal to that of from one to two standard candles.

In the chimney, on opposite sides, there are two narrow slots about three-eights of an inch long. By turning the wick handle below, the flame is adjusted until its tip is between the top and bottom of the slots. If the tip be kept between these limits there is no measurable variation in the intensity of the light emitted by the flame.

This standard is very constant, easily handled, portable, less affected by drafts than the amyl-acetate, and is fairly white in color. The writer has found it more reliable than any of the other standards named.

The Violle standard is the amount of light emitted by one square centimeter of molten platinum at its freezing point. This is doubtless more nearly the ideal standard than anything else yet proposed. It is, however, only possible to use it in a laboratory having special facilities, and it does not call for description here. It is equal to about 18.5 sperm candles.

[To be continued.]

Benj. F. Thomas.

THE FUTURE OF ELECTRICITY.

At the annual banquet of the Western Railway Club, held in Chicago September 18, Mr. L. B. Stilwell, of the Westinghouse Electric Company, in responding to the toast "Electricity as a Motive Power for Surface Railways," said in part:

Electricity never stretches, never breaks, weighs nothing, can be subdivided indefinitely with great ease, can turn corners without loss. It can transmit large amounts of energy at pressures easily controlled along wires of moderate size, and it never freezes. Its loss by friction is comparatively insignificant, and its other losses in comparison with every other known agent are almost negligible.

It is interesting to note that in employing electricity we are using not a solid, not a liquid, not a gas, but ether—that mysterious something which, as modern science teaches, penetrates all matter and fills all space. We cannot accurately define electricity, but this much at least is known. Electricity has to do the same medium that transmits light; it is as swift, as light and as strong as steel; it weighs nothing, and yet, if compressible at all, it is certainly less compressible than any known material. Let us say a push applied to one end of a circuit in Chicago is instantly felt at the other end in New York. We have within a few years come to recognize electricity as the nerve system of civilization. We are just beginning to realize that it is also muscle. We may hope that at no distant day great systems of electric conductors, noiseless, motionless, giving no sign of the work they are doing, radiating from central stations suitably located, will propel every car and train and every wheel of industry in our cities.

Power can be far more economically developed in large quantities than in small, even where coal is the source from which it is derived, and, making all allowances for losses in transmission through conductors and conversions in motors, it is cheaper to-day, so far as the cost of power is concerned, to propel suburban trains by electric motors than by steam locomotives; and where a transmission system is adopted, it becomes possible to utilize any cheap power, which may be found within reasonable distances—say twenty-five, or even fifty miles. It is entirely within the limits of the possibilities of electric traction as now developed to operate trains within the city limits of Chicago by power transmitted from the drainage canal near Joliet.

In view of the facts to which I have briefly referred we are, I think, justified in concluding that a broad view of the situation indicates that electric traction is destined to generally supersede all other systems of traction in our large cities and their suburbs. To what extent electric traction will, in time, compete with steam in cross-country service it is yet too early to say, but, if I may be allowed to express my personal opinion, I should say that where distances are great and traffic comparatively light, it will be a long time before steam locomotives are superseded. For the cities, however, the change cannot well come too soon. It is true that the best means of transmitting power from the central station to the moving car has not been conclusively fixed upon. The overhead trolley, the conduit, and the systems in which the contact points under the moving car are charged as the car passes, and discharged when the car has passed—these, and perhaps others, are to-day in practical operation, and in no small degree successful, but they have not been in use for a sufficient length of time to make it clear that any one is superior to its competitor—in fact, it is altogether probable that here, as well as elsewhere, we shall find that no one system is best for all cases; that various methods must be employed to meet different conditions.

ANTIQUITY OF ELECTRICITY.

The Nineteenth Century, especially this latter half of it, has been entitled the electrical age. But since the startling discovery that Joseph in Egypt was the original single taxer, no one need be surprised at the announcement that the ancient prophet Moses, was probably the father of electricans, says the Minneapolis Times. As King Solomon declared, there is no new thing under the sun. The theory that electricity, which this age prides itself upon as its own peculiar glory, is as old as the Ten Commandments, and was well-known to the Israelities if not to the Phoenicians, has been advanced by a shrewd Biblical student, C. B. Warrand. As Piazzl Smyth has sought to establish his wonderful astronomical genius of the old Egyptians by a thorough investigation of the Pyramids; so Mr. Warrand has brought modern science to bear upon the Ark of the Convenant and the temple of the ancient Israelities.

When Moses built his box for the Commandment tablets he rejected the common cedar and other native woods and chose fir wood, which had to be imported by the Phoenician merchants from the southern part of Europe. Now fir happens to be the best known non-conductor among all the great number of various timbers. Furthermore, Moses had this fir box lined inside and out with beaten gold, thus converting the Ark of the Covenant into a very expensive, but very perfect Leyden jar, or storage battery for electricity. Gold is one of the best conductors of electricity. "Edison or Tesla," declares Mr. Warrand, "could not have improved upon Moses' fir and gold box." The carbon in the fire of the Ark of the Convenant was an essential element. Aaron improved upon this by building poles 50 ells (150 feet) high. These poles were covered with beaten gold, and gold chains were hung from the poles to the Ark--a method by which the prophet secured a complete and powerful electrical connection. His sons were killed without wounds or bruises, by fire breathing out of the Ark.

Investigator Warrand has explained that in order to deal death from this apparatus Aaron had only to remove the camel's hair carpets, which are almost perfect non-conductors of electricity, and make the culprit stand on terra firma. That several members of the revolting tribes of Israhties were thus electrocuted is almost a matter of record in the Bible. In building the temple, Solomon found that copper would do as well as gold. He had the temple covered with copper, and copper waterpipes led into the cisterns inside the temple. On the temple, or rather on its roof, a number of gilt spears were placed in vertical positions, from 16 to 24 feet high. All these curious facts may not be convincing, but they certainly compel us to wonder if, after all, some of the laurels of Franklin may not belong to Moses.

The Arlington Street Unitarian Church of Boston is being fitted with an electrical organ and electrical chimes, the latter consisting of sixteen bells.

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AMERICAN RAILWAY ASSOCIATION CONVENTION.

Street Car Magnates Will Hold their Fourteenth Annual Meeting in Montreal, October 15.

On Tuesday, October 15, at 10 a. m., the fourteenth annual meeting of the American Street Railway Association will convene. The meeting will be held in Windsor Hall, Montreal. The association comprises 178 of the leading companies in the United States and Canada, and the annual meetings are occasions of both pleasure and profit. In connection with the approaching meeting there will be an exposition of street railway supplies. The display will be held in the Victoria skating rink just across the street from the convention hall, and judging from the list of entries made, there will hardly be any appliance missing that is of value in street railway service.

A number of special committees appointed at the Atlanta meeting last year will submit their reports this year. Among other subjects thus specially investigated are "Transfers," "Municipal Ordinances," "Labor Question—Wages Paid to Employes," "Experience of Roads in Furnishing Free Music and other Entertainments to the public," and "Physical Operation of Roads."

During the meeting, which will continue from October 15 to 19 inclusive, a banquet will be given in the Windsor Hotel. It will be a brilliant affair, and a leading feature of the social side of the convention. Each company that is a member of the association will be entitled to two free tickets to the banquet. Additional tickets will cost $10 for gentlemen and $5 for ladies.

A matter which will doubtless come before the convention is the report of a special committee appointed at the last annual meeting to consider the advisability of organizing a department of the association to handle matters pertaining to Patents. The special committee consisted of Messrs. McNamara of Albany, Wason of Cleveland and Green of Chicago. They looked the matter up quite fully and reported, as directed, to the executive committee of the association which met in Montreal last January. The executive committee in turn endorsed the report, and will present the subject matter at the general convention. The report points out the trouble and expense that has resulted to railway companies in connection with alleged patents, many claims being paid for the use of some device or other rather than incur the expense of contesting the same. It is believed that a great number of these alleged patents would become common property on account of the patent feature being eliminated if the matter were properly looked into, and it is to the end that such an investigation may be made that the Association is recommended to establish a bureau which shall deal with such matters, thus relieving the individual corporations from the attendant annoyance and greater expense. This bureau, it is recommended, shall be charged with an investigation of all patents and improvements affecting the interests of street railroad companies, and that the expense shall be borne by them in proportion to their gross earnings. A similar organization has been in existence in connection with the steam railroads for the past twenty-four years, and has been found to work very satisfactorily. It is the practice of the roads not to put any device into operation until it has been referred to and reported on by the bureau specially charged with this service.

Another matter that will come before the convention is insurance. It is insisted by some members that companies can best insure their own property. A few of the members advise the creation of an insurance auxiliary for the insurance of street railway property.

Still another matter is one that will be presented by Vice-President Bean, of St. Joe, Mich., agitating the consolidation of the association with the National Electric Light Association. The contention is that as nearly all the roads are using electricity and many of them are supplying light and power as well, the interests of the two are identical. The larger roads, however, will object to the alliance as their electrical interests are purely incidental, and they suggest that they might just as well ally themselves with a car wheel association or one interested in car building. These larger companies do not sell light and power, and their only use of electricity is to run cars.

OFFICERS OF THE ASSOCIATION.

JOEL HURT,
President.

W. WORTH BEAN,
1st Vice-President.

COL. J. H. CUNNINGHAM,
2d Vice President.

RUSSELL P. HARRISON,
3d Vice-President.

Since the last meeting held at Atlanta, the association has lost one of its most valued members by the death of Wm. J. Richardson, of Brooklyn, N. Y., who has been the secretary of the association since its organization.

Mr. Richardson was born in the city of Albany, N. Y., October 22, 1849, and was therefore at the time of his death, (which occurred April 28, 1895) in his forty-sixth year. His early education was obtained in the experimental department of the State Normal School at Albany. Leaving this school he attended the Albany branch of the Bryant & Stratton series of business schools; until, in consequence of the election of his father, Mr. William Richardson, to the presidency of the Dry Dock, East Broadway and Battery Railroad Company, of New York; in the year 1864, he removed (with his parents) to New York city where he finished his business school education and entered the English importing hardware business at the age of sixteen years.

In 1867 Mr. Richardson left his employers to assist his father in the railroad business in Brooklyn. In 1869 he entered the collegiate department of the Brooklyn Polytechnic and Collegiate Institute, in which he remained three years.

In 1872 he was elected secretary of the Atlantic Avenue Railroad Company of Brooklyn, which position he held until within ten months of his death. In 1873 he married Mary C. Raymond, a daughter of John H. Raymond, L. L. D. Mr. Richardson was a deacon of the Hanson Place Baptist Church, and also an active officer in several societies of a progressive character.

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As a railroad employer he was respected and loved by his men, holding the one position for twenty-eight years. He was always courteous to his men, believing that to treat one's employes as man to man meant to gain their respect and regard. An old maxim he often quoted was "Put yourself in their place."

In 1882 Mr. Richardson was elected secretary and treasurer of the American Street Railway Association. In 1883 he called to order a convention of New York State railroad men, who elected him its secretary and treasurer. It was Mr. Richardson's belief that every State of the Union should have its own street railway association, and he firmly believed that in time this would be the case, and that the American Street Railway Association would be the lever by which this grand work would be done. To him both associations had a wonderful future before them. He was the secretary and treasurer of both associations from the time of their organization until his death, being re-elected annually. This speaks well for his fitness for his position and the regard in which he was held. Last, but not least in his estimation, came the Atlantic Aid Association, which he founded among his employes, who took for their motto, "Affection and Assistance in Adversity." This association was organized in 1890. He felt strongly on the question, and believed that every railroad company should have such a society. His example has already led several roads to adopt the same plan. He was a man of rare ability and humanity. The pronoun I was rarely used by him. He thought, planned and disposed of an enormous amount of business in a quiet, unassuming way. His love for his associations was known by all his friends. Few men had a wider knowledge of railroading. He studied it on both sides of the Atlantic, having been to Europe

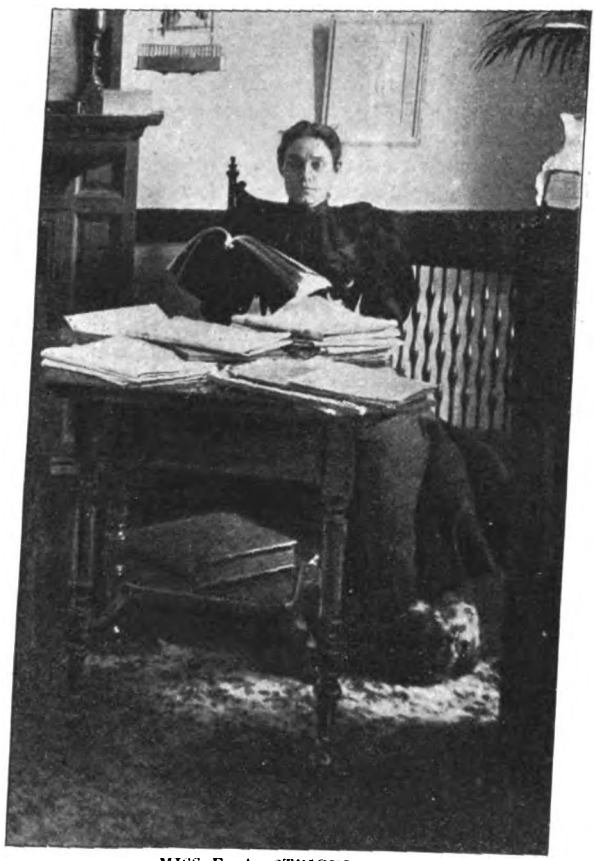
WM. J. RICHARDSON (DECEASED),
Secretary and Treasurer.

four times, and having, on one of his trips, through the kindness of Myles Fenton, then general manager of the Metropolitan Railway of London, been afforded special facilities for inspecting the system of transit in that city. He crossed the ocean last summer to attend, by invitation, the International Railroad Convention in Germany.

No other member of the American Street Railway Association was better liked than Mr. Richardson. He was a man of commanding appearance, his character was irreproachable and his nature kind and gentle.

Mr. Richardson left scores of warm friends among the electrical and railroad fraternities.

Since the death of Mr. Richardson, the duties of secretary of the American Street Railway Association as well as of the New York State Association, have been very ably discharged by Miss E. A. Strickland, acting in conjunction with Mr. John N. Partridge, secretary pro tem. Miss Strickland has the advantage of being thoroughly familiar with the work, having been with Mr. Richardson for the past seven years during which time it has devolved upon her to do not only the detail work, such as handling the bulk of the correspondence, keeping the books, tabulating the statistics and preparing the yearly reports, but



MISS E. A. STRICKLAND,
Assistant Secretary.

during Mr. Richardson's frequent absence, sometimes as long as two months at a time, she had to take entire executive charge of such affairs of the association as came within the scope of the secretary—treasurer's office. At this particular time Miss Strickland is one of the busiest of women getting matters in shape for the forthcoming convention.

DECISION IN FAVOR OF WESTERN ELECTRIC.

In the suit of Western Electric Company *vs.* Brush Electric Company on patent No. 476,317 issued to C. H. Rudd, June 7, 1892, for system of testing electric circuits, a final decree was entered September 19, by Judge Showalter, of the United States court finding the patent valid, and infringed by the Brush Electric Company.

The patent in question covers a system of locating grounds and other troubles on an electric light circuit which consists in providing an artificial circuit of high resistance at the station and adapted to be connected to a line circuit, the resistance of the artificial circuit being fixed and so apportioned between contact points that the attendant, by means of a testing set, may find the neutral point in the artificial circuit corresponding to the neutral point of the line circuit connected therewith.

Claim 1 of of the patent is as follows: "In an electric light system, an artificial circuit containing high resistance of invariable amount, said artificial circuit being connected with the different sides of a dynamo-machine while supplying current to a working circuit, said artificial circuit having its resistance apportioned between connecting-sockets, in combination with a testing apparatus for determining the neutral point of said artificial circuit, substantially as and for the purpose specified."

The General Electric Company secured the order of the Pittsburg Reduction Company for six generators. The price is $65,115.

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ELECTRO-THERAPEUTIC DEPARTMENT.

ELECTRO-MAGNETIC BASIS OF PHYSIOLOGY.*

Prediction that All Kinds of Ailments Will Soon be Met by Electro-Therapeutic Practice.

A living thing, whether plant or animal, is made up of protoplasm. If it be one of the so-called higher forms it consists of a great number and variety of cells, all acting concertedly for maintaining the integrity of the whole as an organism. If it be one of the simpler ones there may be a few or only one cell, that one assuming various functions for nutrition, reproduction, movement and so on, and may be there is a substance which is without form or structure, except what surface tension and simple chemical admixtures may give to it, which possesses, in some degree, this quality, which we call life or vitality. Some microscopists think they can descry in this living stuff, which is without differentiated parts, a fine net work, a mesh in which chemical reactions take place, and thus think they save the idea of mechanical structure as an essential condition for living matter.

A minute speck, only the ten-thousandth of an inch in diameter, can hardly show any organization, if it has it, but its movement, growth and multiplication may be seen. Such a speck must be made up of millions on millions of atoms of whatever sort may compose it. If we assume the average diameter of an atom to be the fifty-millionth of an inch, then a particle the ten-thousandth of an inch in diameter would contain five thousand contiguous ones in its diameter, and the cube of that number, which is 125000-0000 0, in its whole structure. Is there any one who can think, for an instant, that the smallest living thing which can be seen can be the smallest living thing? If not, then how can the microscope ever be serviceable in settling the question of spontaneous generation? To ask the question in this way is to ask, suppose the doctrine were true, how could it be corroborated by observation? I do not recall that any one has stated or given reasons for thinking there are *cell structures* smaller than those which the microscope will now reveal. The protoplasmic masses of all degrees of magnitude down to, say, the fifty-thousandth of an inch, are noted and described more or less minutely. Huxley speaks of an amoeba as a "blob of jelly," but it is a living thing. The step from cell structure to a blob of jelly is a step from form to substance, and makes it needful at once to reconsider the relation which life sustains to matter in general.

If life be the cause of organization rather than the result of organization, as John Hunter thought, then one is driven to molecular groupings, and the study of morphology, carried never so minutely, will discover only what life *does*, not what it *is*. The microscope adds to the number of known forms, not to to their intelligibility.

Vital force as an agency, extra-material in its nature, was assumed as imposing upon organized matter the functions of life. After the discovery of the conservation of energy, the doctrine was shelved, for it was made evident that the energy for running the physiological machine was supplied by the food and air provided, and that no more work was got out of the mechanism than the mechanical equivalent of the material if consumed in any other kind of an engine. Dr. Carpenter early applied the doctrine of the conservation of energy to physiological processes and correllated vital actions with chemical, thermal and electrical actions. But chemical, thermal and electrical actions are not only correlated, they are transformable into each other, so that when, for instance, chemical actions result in heat, the chemical activity is annihilated while heat is practically created; that is, one is transformed into the other and no longer exists. Applying this to vital actions, vitality or life would be but a form of energy transformable into others under proper conditions. Now the proper conditions for the transformation of one kind of energy into another is some kind of a mechanism. If heat energy is to do the work it must be provided with an engine. If it is to appear as electrical energy it must have a thermopile, and if electrical energy is to beeome mechanical energy it must have a motor, and so on. If then the analogy is to hold in vital phenomena, if chemical energy is to be transformed into vital energy, there must be some kind of a transformation, and if a cell in the physiological sense is not necessary, then the mechanism must be the molecules themselves. If, too, life be the cause of organization, then it must be behind all organization, and if it be behind organization and conditions organization, then it would seem that one must look even beyond the molecule of any kind for the agency that organizes. Molecules are more than simply aggregates of atoms. There is organization, and a very definite one, too, in the simplest of them, as all chemistry shows. Crystallization is a geometric organization, but the more complex the molecule the less stable it is, that is, the easier it is broken up into more stable compounds. Now protoplasm is highly complex, probably more than a thousand atoms in its molecule. It is more proper to speak of it as a mixture of many slightly cohering molecules, water, oils, alkalies and acids, within which chemical and physical actions are going on all the time, exchanges and transformations of energy. Butschli and others have shown how to make, in an artificial way, an emulsion which behaves like an amoeba; putting out pseudopodia, gathering in and assimilating external material, and moving about—all fundamental physiological phenomena.

So far the functions of the natural and the artificial are identical. Must one not say that such behavior in an artificial compound reduces those functions in living things to physical and chemical activities alone, thus narrowing the distinction between so-called living and non-living matter to the single one of re-production! Growth, movement, assimilation and re-production are the physiological functions of living matter, and these can be carried on in structureless matter, unless one enlarges his definition of structure so as to include *bubbles*, emulsions, and surface tension arrangements, and here is where vital phenomena are now tracked. Is it not plain that matter which possesses in itself so great potencies as we already know has very different attributes from those commonly assumed when it is spoken of as "dead" and "inert?"

So long as forces were supposed to act upon matter compelling it to act thus and thus, there were as many forces invented as were thought needful for the theory. These were only looked after philosophically when they were on duty. When off duty no one thought or cared to know what became of caloric, electric and magnetic fluids and chemical affinity. Caloric was dismissed a long time ago. Nobody talks about the electric fluid now any more than he does of magnetic fluid, and as for chemical affinity, it has been proved to be non-existent where the temperature is low. In his book on Modern Theories of Electricity, Prof. O. J. Ladge implies that the existence of electricity itself is becoming problematical, that electrical phenomena no more imply the existence of a something called electricity than do thermal phenomena imply the existence of caloric. The phenomena themselves may be explained by stresses and movements in the ether, produced by the activity of the atoms of matter. As all kinds of atoms exhibit electrical and magnetic phenomena in some degree, depending upon their condition, environment and combination, it appears needful to assume for atoms of all kinds of matter electric qualities which are as inherent in them as is any of their other qualities, such as gravity, elasticity and mass. Indeed, for the explanation of the simplest chemical reaction, it is now believed that each atom posseses a definite electric charge, and all reactions in solutions represent transfers of electric energy, and the separated parts are called *ions*, whether they be as solids, liquids or gases. It is believed

*Paper read by Prof. A. E. Dolbear, September 19, before the National Electro-Therapeutic Society in Boston.

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that no chemical action can possibly take place when the conditions do not allow electrical changes.

The meaning of all this to the physiologist lies here: every physiological action whatever represents some sort of a chemical change. The contraction of a muscle, the maintenance of temperature, the secretions of all sorts, and digestion in all stages. There is no reason for holding that a chemical reaction within the body is different from what it would be out of the body, and if out of the body all chemical reactions are electrical phenomena they must be held to be the same within it.

More than forty years ago Faraday investigated the relations of the elements to magnetism, and found that all of them were subject to it, varying in degree, and he concluded that all kinds of matter were magnetic in some degree, and since then it has been further learned that temperature disguises the effects in a marked manner. Thus the element oxygen appears as slightly magnetic at ordinary temperature, but it is strongly magnetic at the low temperature of—100° C.

Such a statement as that implies that the magnetism of a body depends upon its temperature, whereas it is known that magnetism is a property of the atoms themselves, and there is no evidence that it is variable. What we call magnetizing a piece of iron means only that its molecules are arranged in such a manner that the magnetic fields of all the atoms act conjointly with each other, and thus give an external field; the atoms are no more magnetic than before.

At absolute zero magnetic quality would be at its maximum, but temperature gives rise to chemical activity and to molecular arrangements, which disguise the quality by overlapping fields, and chemical re-actions re-arrange the magnetic stresses, and result in electric currents in short molecular circuits.

For these two reasons the two words electro and magnetic are combined to indicate that where there is a magnetic disturbance, there electrical phenomena always appear.

Apply this to physiological phenomena, normal or abnormal. Every organ is built of units, called elements, which are of an electro-magnetic nature in their properties, in the same sense as they are gravitative. Whether they be organized in one way or another will make no difference, except in the degree of complexity, and every change brought about through them, or by them, is a change in electro-magnetic units with disturbances in magnetic fields, in electric changes and transient currents. The mere fact that they take place in the body of an animal or of a man makes no difference, and we may, therefore, hold that the basis of physiological activity of every kind is electro-magnetic, and that a complete knowledge and understanding of such functions will only be reached through the study of structures and products as related to electrical laws and phenomena.

The body is an electro-magnetic machine, and electro-magnetic conditions regulate all its functions.

These considerations give validity to electro-therapeutic study and a rational basis for effort, and one may look forward, confidently, to the swift coming time when all kinds of ailments will be intelligently met by electro-therapeutic practice.

ZINC-AMALGAM CATAPHORESIS.*

Satisfactory Application in Muco-purulent Inflammation and Malignant Growths.

In spite of having written two papers on the use of zinc-amalgam cataphoresis during the past year, which were read before medical bodies of less specialized character than the present meeting, I feel that the practical importance of this subject is so great as to demand a place in the present programme. After the labors of Gautier, of France, and of three fellows of this association, Drs. Goelet, Morton and Cleaves, I cannot say that there is anything absolutely new in the methods about to be described, except the use of mercury as the cataphoretic metal, and possibly the mode of it sapplication to malignant growths. Yet some important things in scientific art have been but synthetic combinations of the ideas and labors of others, yielding results that had possibly been previously attained in part, though not appreciated.

Zinc-mercuric cataphoretic applications are, I believe, such an important modification of the galvano-caustic method as to supercede all other forms of employing the positive pole of the galvanic current in muco-purulent and hemorrhagic endometritis. Were it not that the brittleness of zinc illy adapts it as an electrode for small or tortuous cavities there would be no further use for costly platinum electrodes in the treatment of these conditions, for I have cured a number of cases with the amalgamated electrode that had been only slowly improving under the use of platinum and carbon instruments, and can see no disadvantage in the mercurial diffusion even in cases where it is not asbolutely indicated. In my present choice of instruments for hemorrhagic and purulent endometritis I therefore invariably employ the amalgamated electrode in cases that are sufficiently patulous for its easy insertion, using either the stiff curved platinum electrode or the spiral platinum electrode for non-patulous or contracted canals.

Parenthetically it should be stated that there are cases of mere catarrh, of course, in which we do not wish true cauterization of the endometrium, but rather a trophic stimulation of the membrane and contraction of the parenchyma, and in these cases I prefer to cover the spiral electrode with a tight layer of absorbent cotton, like a narrow cotton swab, which is wetted and soaped for easy insertion. The cotton should be burnt off after use. This method, when it can be used, is a typical plan of treatment of the milder conditions and even of a pronounced metro-salpingitis, as it offers a mimimum of traumatism to the cavity or to surrounding adhesions. The cotton after withdrawal, moreover, offers a very accurate index of the condition of the cavity, by the varying appearance of the discharges with which it is saturated.

Mechanically the amalgamated zinc electrode offers, in cases in which it can be used, greatar ease of insertion than a platinum, and especially than an uncoated zinc or a carbon electrode, as the well-known oily sensation of a freely amalgamated surface indicates a condition of actual lubrication. This is possibiy one explanation of a fact I have noted, that its use in hemorrhagic cases is followed by less immediate flow than former methods, and at times by none at all. On withdrawing the electrode, also, there will be found to be no true adhesion between it and the morbid surface if it has been freely coated with mercury, even when a strong current has been used, though a contracted uterus may make it fit tighter.

Clinical experience with this method, in obstinate cases of hemorrhagic endometritis has made me think that there must be some special efficacy in the nascent mercuric salts thus conveyed into the affected tissues. That mercury administered internally has a so-called antiphlogistic action has been well known for years. In the light of our present knowledge of the true nature of sub-acute inflammations it may be possibie that this antiphlogistic action is due in part to a stimuiation of the phagocytes that have been developed, more particularly in this class of inflammations from the fixed tissue cells of the inflamed part. By this destruction of morbifi germs and reenforcement of defensive agencies we may start a reparative effort resulting in a disappearance of the wandering cells of a parenchymatous or exudative inflammation and a growth of the embryonal cells into fully equipped fixed tissue cells. It is of course not claimed that the only antiphlogistic action of mercury taken internally is the local one, for some of it must be due to regulation of the liver and other abdominal organs, but the effect of this interstitial dissemination of the agent by cataphoresis shows that internal medication when effective must be partly local also.

If mercury taken by mouth may by vascular transference affeet distant localities how much more effective may not its local electric diffusion be?

Strong testimony of such efficacy is contained in the clinical

*Paper read by Dr. G. Betton Massey, of Philadelphia, at the Toronto Convention of the American Electro-therapeutic Association, Sept. 5th, 1895.

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histories of three cases reported by me to the Gynecological Section of the American Medical Association. In two of these cases a prolonged treatment with the platinum and carolon anode had failed to completely cure a hemorrhagic endometritis with attendant leucorrhœa and menorrhagia, though much benefitting them; on substituting an amalgamated zinc anode a prompt and satisfactory cure followed. The third case reported was one in which a continuously dribbling hemorrhage had appeared after the menopause, the uterus presenting a tumerous enlargment. The persistence of the hemorrhage and pain in spite of ordinary galvanic treatment conspired with other clinical signs in suggesting malignancy, but in this case also a symptomatic cure resulted from the metallic treatment, which has continued to the present time. Several other cases presenting hemorrhagic features, with and without floroid degeneration, have been treated since, with unvarying good results.

The application of this method to incipient cancerous growths would seem to be rationally indicated, for by it we may add to the tissue killing properties of a concentrated anode the additional effects of nascent oxy-chloride of mercury and zinc, thus obtaining all that there is in the caustic treatment of cancer, plus the electricity, and without the long-continued pain of caustics as ordinarily applied. The nascent caustic materials will also be carried into the tissues by the current, reaching the outlying ramifications of the cancer, particularly in those growths in which the cancerous structure is a better conductor than surrounding healthy tissues. To do this the monopolar method is of course essential, making it a distinctly different procedure from Inglis-Parsons' plan of treating cancer, in which no special attempt is made to follow the cancerous ramifications by current diffusion.

For this method to successfully replace the knife in the treatment of so grave a condition, it must partake of some of the elements of rapidity that distinguishes that method of rapid removal, for the knife is to-day almost universally resorted to in spite of the admissions of its most eminent practitioners that it does not cure but often makes the final condition of the patient more deplorable. Heavy currents should be used to produce quick and far reaching results. Up to the present time I have not exceeded 350 milliamperes in such monopolar applications on account of the pain, but it is my intention to make these applications under anaesthetics more frequently in suitable cases in the future, cocaine administered cataphoretically at the time of application having done much to lessen the pain in several cases, and bring such a current to bear on the diseased tissue as to thoroughly change its chemical and morphological character, conveying the effect to the remotest ramifications of the growth. To accomplish this successfully with a current pressure of not more than 150 volts and without damage to the healthy skin with which the other electrode is in contact we must make this indifferent electrode very large and a good conductor. A bath contact of most of the body surface would possibly answer well, but I have successfully employed a more convenient device in which large wired-cotton pads of uniform thickness and moisture covered the greater part of the back, abdomen, hips and thighs, the patient lying on those adjusted to the back, and the several wires from each being carried to the negative binding post of the battery.

In this manner a chemical destruction and metallo-caustic impregnation of the diseased tissue of any extent may be employed, and though I have reason to believe that an active defense is aroused in the surrounding healthy tissues which will do much to limit further extension of the disease, the application does not usually add to the patient's discomfort, but rather tends to lessen pain and other symptoms. In one case reported by me to the Philadelphia County Society in which the cancer was situated in the groin, the central portion was gradually destroyed and ultimately replaced by healthy tissue, but unfortunately the growth involved the femoral artery, over which it lay, at which point no treatment was of avail. In another case in which the cancerous growth began in the left tonsil and spreading to the soft and hard palates was about to produce death from suffocation and inanition, the treatment was entirely successful, more than a year having now elapsed since a complete restoration of the normal integrity of the parts was attained.

If more than mere alleviation is demanded of this method the cases selected should be strictly local and unaccompanied by glandular infection, and unless very strong currents are to be used the method should not be employed in cancers of large extent.

General News.

Washington Monument was struck by lightning September 18. No material damage was done. Lightning has on several occasions played pranks with the monument and it would probably long ago have been destroyed but for the fine system of lightning arresters with which it is provided.

The executive committee of the National Electric Light Association has appointed a sub-committee, consisting of John A. Seely, E. F. Peck and A. J. DeCamp, to consider the matter of holding an electrical exhibition in connection with the next convention of the association, to be held in New York in May, 1896.

In 1886, when the Edison works moved from New York to Schenectady, 400 men constituted the working force, and they found quarters in three moderate sized buildings. Today 4,500 men are employed by the General Electric Company, successors to the old firm. They occupy 65 buildings, utilizing 40 acres of ground.

The Board of Appeals of the United States Patent Office has just reversed the decision of the Primary Examiner and has granted the right to protection upon what is appropriately and conveniently termed "flexible mica" for insulation, recently introduced by the Mica Insulator Co., of 218 Water street, New York City. Edward P. Thompson, of New York appeared for appellant.

A correspondent asks the Electrical Age if it is not practical to carry enough stored electricity and use it for the purpose of heating the body by means of a system of electric heating apparatus placed under the clothing. In reply the Age says they presume it is. A few 200-ampere hour cells scattered among pockets, connected in series, ought to do the business. They would probably weigh 500 pounds or more; and to this must be added the weight of heat apparatus. The latter need not necessarily be in the form of a street car heater; it could be spread out on a flat surface. It would not look well, for instance, to carry a box-shaped heater across the stomach. Care must be taken to prevent short-circuiting, which might result in roasting to death.

A lively telephone war is promised in Philadelphia, where the Mutual Automatic Telephone Company is preparing to do business under the provisions of a franchise recently granted them. General Clarkson is the president of the new company which is a local branch of the Pennsylvania Standard and which in turn is a branch of the National Standard Telephone Company. The new company contemplates a sweeping reduction in present rates. At present it costs one dollar to telephone from Philadelphia to New York. The Mutual proposes cutting the rate to twenty-five cents, and general service at the rate of fifty to seventy cents a month is promised. General Clarkson in speaking of his new company said: "The patents covering our telephones, switchboards and other details are unassailable and will stand in law. Our telephones and other instruments are superior to any yet invented and our whole system can be constructed at so much less expense than that of any other company, that we shall be able to provide the cheapest rates that can be given to the public for a first-class service. Our system provides for many improvements. Every telephone we put in will be a long-distance instrument and all other appliances will possess superior merits over the old companies."

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THE STORAGE BATTERY.

Reply to Anthony Editorial in September 1 Issue of The Electrical Journal.

In the September 1st issue of THE ELECTRICAL JOURNAL the editorial remarks on "The Storage Battery" contain sufficient inaccuracies regarding storage batteries and the economical aspect of their industrial application to traction puposes as to invite, we think, no little criticism.

To begin, the statement is made (regarding the want of success of storage batteries) that "the drawback has been the great first cost and rapid deterioration" of the plates. Now, as to first cost, it must be said that you do not seem to take into consideration the fact of the special application a storage battery has—and the conditions under which it is used—in light and power stations. The function of a storage battery in a central station, among other things, is to augment the output of the plant when the load is greatly in excess of the capacity of the machinery. This the storage battery is enabled to do by its ability to furnish current several times in excess of its normal discharge rate. At the meeting of the National Electric Light Association, held at Cleveland, O., in February of the current year, Mr. C. L. Edgar, general manager of the Boston Edison Illuminating Company, which is owner of the largest storage battery installation in the world, said that, if it cost $100 per horse-power to install direct supply machinery, storage batteries to handle the maximum load, lasting only one and one-half hours, were being put in at $50 per horse-power. So that a plant consisting of half steam power and half storage battery would have double the capacity of the steam power part, and only cost three-quarters of what a complete steam power plant would cost for the same work. As a matter of fact, as an adjunct of a steam power plant, *the cost and depreciation of storage batteries is less than that of boilers, engines and dynamos, while the system is more efficient and the service more reliable.*

Again, you say that storage batteries were used for lighting trains between Boston and New York, *without success*. The only comment we would make upon this is that the choride accumulator is used *with success* for train lighting. In 1894 the Intercolonial Railway of Canada installed 350 of our cells for train lighting purposes. After using them a year they duplicated their order. Does this make it appear that our cells were not a success in this sphere of work? The Pullman Car Company are using our cells with increasing success in this same kind of work.

You speak of the chloride accumulator as a "lead plate, lead oxide battery." Now, the "chloride" cell is in no sense a lead oxide battery, as that phrase is understood. The cell is made by casting lead under pressure around pastilles of chloride of lead. This chloride of lead is then altered to metallic lead (in negatives) and peroxide of lead (in positives) by purely electrolytic processes. This disposes of some of the inaccuracies referred to.

Taking up now the economic aspect of storage battery traction, you say that "the cost of the central station plant for charging batteries would not be much different from that of a plant to run the cars direct." Our opinion is that the difference is *very great*, amounting to, at least, a saving of one-third of the cost in a plant used for charging batteries. The important factor in deciding this point is the relation between the average and the maximum load on the machinery. We have data concerning this point for a number of roads and these show a difference between the average and maximum load of from 20 to 1200 per cent. O. T. Crosby puts the relative size of a power plant for the direct and the storage battery system as 1:½. This is a less favorable figure than is justified by the conditions governing the operation of numerous roads in this country. Assuming that the ratio is fair, an economy of 33 per cent in cost of construction, involving, as it does, a diminished cost for real estate and building, is a very strong point in favor of the storage battery system.

Again you say, "there is the cost of the storage battery equipment to offset the saving in line, and, perhaps, subway. Which of these would be the greater would depend upon the conditions in the given case." With regard to a comparison between the cost of underground conduit construction and that of storage batteries, we cannot conceive how the two costs could approximate each other, unless about eight cars were run to every mile of underground conductor, which is a condition not met with in practice. Taking all the trolley lines in the country, there is on an average only two cars per mile of track. The cost of the line equipment, including poles and feeders, especially where, as in cities, the latter must be buried, is about $12,000. The cost of storage batteries for two cars would be about $7,500. So that while it is conceivable that the cost of storage battery equipment may exceed that of the overhead or underground part of the construction, *average* conditions would render the storage battery equipment considerably cheaper.

Further, you say, "The loss of energy would not differ greatly for the two modes of propulsion. For short lines the loss would would be against the battery." Whilst we agree with the implication that for long lines the efficiency of the storage battery system is greater than that of the trolley system, we are prepared to go a step further and say that even on short lines the loss of energy in the storage battery system is not greater than in the trolley system. To understand why this is so, consider the relative efficiency of the two systems. For the sake of example suppose the average trolley power plant contains three units which are used, one, two or three at a time, depending on the requirements of traffic. Experience shows that if the variable load were converted into a steady load, the coal consumption could be reduced by at least 20 per cent. Considering the energy contained in the coal, the trolley system has an efficiency, compared with the storage battery system, as 80:100. This represents, practically, the relative energy that is employed in doing work in the steam engine. Assuming that 10 per cent is lost in the steam engine by friction, these figures are reduced to the ratio 72:90. The efficiencies of the dynamos under a variable and constant load being, say, as 80:90, this ratio becomes 57.6:81. Against the loss of 5 per cent on the line, we have (with a battery of 80 per cent efficiency) a loss of 20 per cent in the battery. Making the further reduction, we have the ratio 55:65. With a 70 per cent motor efficiency in both cases, the ultimate ratio becomes 38.5:45.5. In other words, the same amount of the heat energy of the coal furnishes about 20 per cent more energy applied at the axles in the case of a storage battery system than in the case of the trolley system. In the case of long lines, where the fall in pressure amounts to 40 per cent on distant sections of the line, the efficiency of the storage battery system will be very much greater.

Lastly you say that "the cost of maintenance of a storage battery would be much greater than a well constructed line." This is undoubtedly true, since the total maintenance cost of power plant, rolling stock and storage battery is about 1.3 cents per car mile greater than the maintenance cost of power plant, rolling stock and line in the direct system. On the other hand you do not take into account the smaller interest charge and smaller cost for power in the storage battery system. If you did, you would find that this balanced the greater maintenance cost of the storage battery and put the two systems on an equality.

Thus it appears that the storage battery system has first cost in its favor and is not at a disadvantage with the trolley system, even when operating expenses are considered.

MAURICE BARNETT.

CORRECTION.

In the article on measurements of insulation resistance by Wm. A. Anthony, in our issue of September 15, there were one or two errors which call for correction. Formula (4) should be

$$x = \frac{V - (v + v)}{v} r$$

and (5) should be

$$y = \frac{V - (v + v)}{v} r$$

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

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Electrolytic Destruction of Pipes.

The recent suit brought by the American Water Works Company against the Omaha Street Railway Company to secure an order from the court, requiring the railway company to adopt some effective means of preventing corrosion of the water pipes, calls attention anew to this serious phase of electric traction by means of the single trolley. Complaints of injury to metal pipes buried in the earth began to be made almost as soon as an electric railway commenced operating. Several years ago a deeply corroded lead pipe from Saginaw was submitted to me for inspection. It was badly pitted; and, after proper inquiry, no doubt existed that it had been destroyed by stray currents from the rails. Any intelligent attempt to correct this serious evil must be based on well known laws and must include facts established by experience and observation in several cities. Some important conclusions will bear repetition.

In the first place, a metal is corroded in general only where a current leaves it to enter an electrolyte, or in railway practice, where the pipe is electrically positive to the ground. It has been fully established that corrosion is produced even when the potential difference between the pipe and the earth is small. The extent of the damage depends on the volume of the current flowing into the earth, exactly in accordance with the law established by Faraday many years ago.

Further, the amount of the corrosion is increased by the presence of salts in the solution in the soil, chlorides being more destructive than nitrates, and nitrates more injurious than sulphates. A plain deduction is that salt should not be used to remove ice from the rails, since the soil may thereby become saturated with it.

It is now conceded that a good return, consisting of bonded rails and a copper conductor of large size, will not insure complete exemption from trouble, since other paths for the return current are still open. The positive pole of the generator should be connected to the trolley. No harm will then come to pipes at points distant from the station where the current enters them. If now this current can be drawn off from the pipes at points near the generating station, all trouble will be obviated. Hence, conductors of proper size should be run from the grounded side of the dynamo to the several systems of pipes at points indicated by the appropriate measurements as having the highest potential above the earth. In no case should metallic connection be made between the rails and pipes in districts remote from the station, where the pipes are negative to the earth. Such a connection would only aggravate the trouble by diminishing the resistance of those possible returns along which it is desirable that as little current as possible should travel.

In every installation a careful study of the distribution of the street gas and water mains should be made before means are adopted to avoid trouble. A preliminary plan based on such a survey may subsequently be elaborated, if measurements made under actual working conditions indicate that further protection is required.

As to the legal aspect of the subject, it seems probable that action may lie against the railway company. It is understood to be a settled principle of law that companies holding the earlier charters to occupy the streets have aquired prior rights of which they cannot be dispossessed by later comers. This is especially true in cases where no relief from trouble or burdens inflicted by infringing corporations appears to lie within the power of the older occupants of the public streets. Such relief was shown to exist in the case of the telephone companies if they chose to avail themselves of it, and the courts generally decided adversely to their claims. But no such relief appears to be open to the water companies for adoption. Attempts at insulation of the pipes are known to be useless, and the interruption of their metallic continuity aggravates the difficulty by increasing the number of points of attack. It seems therefore not only equitable but necessary that the railway companies should employ every means at their command to insure the public against injury by electrolytic corrosion.

Henry D. Barrett

* * *

Electric Heating for Street Cars.

In the Journal for August 1, appeared an article on the Economical Heating of Cars, which contains a synopsis of the tests by various railways of car heaters of various kinds, and incidentally comparing electric with other methods of heating. Only in a very few cases are electric heaters recommended. In a great majority of cases the statement is, "too expensive." Stoves "more economical," "cheaper in first cost and operation."

As to the greater economy in operation of stoves, there is not, and never could have existed, any doubt. The quantity of heat to be derived from a given quantity of electrical energy is known to a degree of precision not exceeded in any department of science or engineering. It does not matter what the form of the apparatus or the material used, a given quantity of electrical energy spent in a resistance, always develops the same quantity of heat. One form of apparatus may distribute the heat developed to better purpose, may use it with less waste, but no apparatus can do more than use it all.

The current required for heating a car is variously stated as from 3 to 14 amperes. Taking 8 amperes as about an average, this represents, at 500 volts, 4,000 watts, equal to 6 horse-power at the central station. Not many central stations are doing better then 2 pounds of coal per horse-power per hour, and to heat one car, therefore, requires the consumption at the central station of 12 pounds of coal per hour.

But 4,000 watts is the equivalent of 7,500 heat units per hour, and that number of heat units is developed by the combustion of one pound of coal.

Assuming that *all* the heat derived from the electric energy is useful in warming the car, and that, if stoves were used, two-thirds of the heat of the fuel would be wasted—a most unfavorable assumption—three pounds of coal per hour burned in the car stove would warm the car as well as 4,000 watts consumed in the electric heater. This is upon the assumption that the electric heater is perfect, employing usefully all the energy it takes from the line, and that the stove is abnormally wasteful

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Even upon this assumption, 8 pounds of coal burned in the car warms it as well as 12 pounds burned at the central station.

Electric heaters can never displace other means of heating on the score of economy, until electrical energy can be obtained much more cheaply than through the medium of the steam engine. If the electrical energy is derived from mechanical power, it will be cheaper to use coal directly for heating, unless a horse-power can be had for less than five dollars per year.

But it must not be supposed that the electric heater has no claim to consideration. It is cleanly, it occupies no useful space, it can be distributed over the space to be heated and so warm the space more uniformly, it can be turned on when wanted and turned off at once when it is no longer needed, it can be regulated to suit the outside temperature and the demand for heat. We shall use it in many places, as we use many other things without regard to economy, on account of the convenience and freedom from trouble and annoyance which its use involves.

Wm. A. Anthony.

* * *

The Term "Generator."

In this issue a correspondent calls in question the correctness of the definition of the word generator as applied to electrical machines, claiming, that such machines are not generators at all, but "collectors" of electricity from the atmosphere.

I do not know where he could have obtained this idea of the action of a dynamo. No electrical theory with which I am acquainted would lead to such a view. According to the theory most in use and best understood,—the theory that has furnished the language in which electrical phenomena are described and explained, a dynamo developes a pressure,—a moving force—that tends to set in motion the electricity in the conductors which make up the circuit within and without the machine, and when "the circuit is closed" does set the electricity in motion, producing an "electric current."

But independently of all theories, it is worth while to consider whether the term "generator" is appropriate as applied to electrical machines.

The Century dictionary gives as one definition of generate, "to produce;" "to cause to be;" and a generator is "that which begets, causes, or produces." According to this definition anything produced—caused to be—is generated. The thing produced need not be material, it need only be a condition. We may generate pressure, as in a steam boiler; we may generate motion in a foot-ball or a railroad train, we may generate a current of air, or water, or electricity. When anything or any condition that did not before exist is brought into existence—is produced or caused to be—it is generated.

Even if a dynamo did collect from the air the electricity which it sends out upon the line, it would still be correctly described as a generator of electric *currents*, since the electric currents did not before exist, but have been "produced" by the dynamo.

It is not correct to say that a dynamo is a generator of *electricity*, any more than it is correct to say that a fan blower is a generator of air. A fan blower is a generator of air currents. In the same sense a dynamo is a generator of electric currents.

Wm. A. Anthony.

* * *

The Street Railway Convention.

The Street Railway Convention that meets in Montreal on October 15, will have plenty of well cut out work, ready to its hand, and there should be no half heartedness in getting down to business as soon as the convention assembles.

The street railway business has grown to gigantic proportions and during the past very few years, a complete transformation has taken place, so that new conditions present themselves and new demands exist.

An important step was taken at Atlanta when committees were appointed to give special study to a few branches that seemed to require immediate attention. One of these committees had assigned to it the duty of studying the question of railway patents; this committee has already made its report to the executive committee, recommending the formation of a bureau to which could be submitted all patents presented for adoption either by inventors or manufacturers. The convention should lose no time in acting upon the suggestions of this committee. It is impossible for each road to look up the integrity of every patent it is asked to use, and it is a well-known fact that hundreds of patents are in existence and on which royalties are being paid, that are utterly worthless, so far as their patent right is concerned. A standing committee, with power to act, and a fund behind it sufficiently large to enable it to employ an attorney, would save a great amount of money. This committee might also have other duties assigned to it. For instance there is a well defined intention, on the part of the steam roads, to have laws enacted compelling interurban electric roads to pay for their rights of way, instead of occupying the public highways, as they do at present. State legislatures should be watched for this kind of legislation, and the attorneys for the committee could watch them.

Recent developments have indicated another dangerous condition, that confronts the electric roads. In Omaha, a few days ago, the public water company brought suit againt the street railway company for alleged electrolysis of water pipes owing to electrical leakage. A little calm thinking on this point will convince the conservative railway manager that he has here an active danger, and one that may grow into something formidable. It will be admitted that electrolysis does take place where there are leaks, and it will not be denied that electrolytic action is destructive of gas and water pipes. The question that would seem to present itself is, to what extent are railway and light and power companies responsible for damage on this account. We know of course that under the law, no one has a right to destroy private property in order to do business himself, and that compensation is always demanded when such destruction occurs. But we also know that the public good must take precedence of private rights, and that society at large consults itself before considering the claims of a single individual, so that in the interest of the public electrical roads must be operated. Yet, there is a question of contributory negligence that intrudes itself at this point. Are the trolley roads, as they are built at present furnished with all the protective appliances known to the science for preventing leakage and hence electrolysis? If not, are not the roads failing in this respect, liable?

Again these roads operate under municipal franchises, and the conditions of their operation are fixed by the municipal bodies granting them. The question would be natural then, what part of the responsibility in such a case as we are discussing, would fall upon the cities themselves, and what part upon the roads accepting these constructing franchises? Most ordinances contain clauses, citing the freedom of the municipality from all liability in such cases and throwing all the responsibility on the franchise holders, but there has always been a question whether this freedom really existed and the courts have held both views, depending on the particular case in point.

So without proceeding further, it will be seen that several important matters for consideration confront the prospective convention, and that the meeting should be a strictly business session.

* * *

Conduit Trolley in Chicago.

Mayor Swift, of Chicago, returned a few days since from his summer vacation in the East, and in some interviews stated that the conduit trolley was a demonstrated success on the Lenox avenue line, New York city, and that it was the coming system for electric traction. This statement is all very well as far as it goes, but it does not go far enough to do any good. Besides, Mr. Swift's story is not new, and fails to startle anyone who knows anything about the subject.

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As a matter of fact, the conduit trolley was a demonstrated success in Chicago long before it was attempted in New York. More than three years ago the Love system was installed on Fullerton avenue, and was operated for months. President Yerkes certificated finally that the system was a success and he gave figures for the statement. The piece of road attracted a great deal of attention, however, and a number of city councils in the East, notably in Philadelphia, ordered reports to be made with a view to passing ordinances compelling roads to go under ground. The Yerkes syndicate owns the Philadelphia roads and naturally did not want to be compelled to make the change. They therefore acquired the ownership of the piece of Love road, and immediately got it ready for the visit of the Philadelphia council committee. To make a long story short, the piece of Love road has not been "successful" since that time.

However, no one in Chicago who was really interested in the city and its transportation facilities was fooled by the jugglery of three years ago, and an honest and earnest attempt has been made ever since that time to prevent the advent of the overhead trolley on the down town streets. Mayor Swift did not have to go to New York to learn that the conduit trolley is practicable. He was told so long enough ago to make his opposition to the present trolley lines effective. It is now probably too late to do much. The wedge has been started and it will be a tremendous undertaking to make the roads change again, and in all seriousness, there is good ground for the contention on the part of the roads that it would be an outrage to make them change now after they have expended so much money in equipping their roads for overhead service.

* * *

The Buffalo Franchise.

The long hung up franchise asked for in the city of Buffalo by the Niagara Falls Power Company, seems at last in fair way of settlement, and there is good reason to hope that very soon the electrical power people may be supplying power and light in Buffalo. All the hitches have been removed that are of any consequence. The franchise is granted for a term of 36 years as asked by the company, with the proviso only that the rate of payment to the city may be readjusted at the end of 18 years. The clause insisted on by the city, in effect that the company should provide facilities for carrying the wires of two competing companies, was amended to require the company to provide for only one additional company and fixing a limit of time within which the privilege should hold good, also compelling such other company to pay its proportion of installation expense.

On the clause to compel the company to put its wires under ground at any time on order of the council, it was agreed to give the company six months after such order had been given. On the clause fixing a flat rate of 5 per cent of the gross receipts as payment to the city, the company contended for a waiver to the extent of the first 10,000 horse-power of service. The city demurred on the ground that the company might be content to serve only that amount. The matter was adjusted by a waiver of the rate for five years, after which there is a flat rate of 5 per cent. The only other clause that caused trouble was that giving the council the right to annul the franchise immediately upon any breach of its provisions. It was settled by restricting the privilege of the council to a case in which there was proof of wilful violation.

We can readily understand that there was difficulty in arriving at an equitable settlement of so great a matter. A concern that contemplated so great an expenditure of money and without absolute assurance of success, would naturally require large concessions. The city council on the other hand must have felt that the concessions were very great, extending over so long a time. Congratulations and compliments are due the men who engineered the settlement.

* * *

We predict for the members of the American Street Railway Association a pleasant time at Montreal. Canadian hospitality is of a superior brand.

Telegraphers and Consumption.

The British Medical Journal makes the announcement that deaths from consumption among telegraphers between the ages of 15 and 55 years average 44.6 per cent, while among the general public the rate is only 24 per cent. The writer does not point out any special reasons why this condition should exist. If the figures are correct there must be a reason for it, and an attempt should be made to find it, with a view to its removal. The business of the telegrapher is not of a character to subject him to inoculation with the tubercle bacilli from contact with his fellows. Excepting in very large exchanges he is not very closely confined in badly ventilated quarters. Indeed it would be difficult to name a single duty of the telegraph operator that would be likely to expose him in an unusual degree. Nothing seems to be left, therefore, but to attack the figures given by our medical contemporary, and we do so with a good deal of misgiving as to our own position. Is it not possible that the statistician has "lumped" all mankind against the telegrapher? If he has done so, his figures are worthless, because he does not strike a fair average. For instance, no one will contend that the farmer or the cowboy would be likely to die of consumption as a class, and, on the other hand, the sweat shops will show an abnormally large per centage. We venture to predict that if special classes are taken—those whose lives are sedentery and whose business is confining,—the telegrapher will show up well in comparison. But if a class is to be taken in the one case, another class must be taken in the other, and not a heterogeneous mass of mankind. Give the telegrapher a show.

* * *

Fight Over Nomenclature.

Our English friends are again quarreling over our poor nomenclature. Would it not have been a blessed relief if there could have been one great big fight at the Columbian Congress, and a final settlement of the whole "bloomin" business? But perhaps it is the British love of sport that keeps up the "action" on the other side of the water. It is certainly true that for years the British scientists have been trying to agree on new units, and failing in this "consummation devoutly to be wished," they have now called upon the practical electrical engineers to know what new units are demanded. The latter have replied with a plea for less agitation and fuss, fewer new names, and a better understanding of those now in use.

But of course the British scientist must invent new names, since he cannot invent annything else, and equally of course the rest of the world will go on ignoring British inventive genius in this direction.

* * *

Farmers and the Trolley.

President Dunstan, of the Canadian Electrical Association, in his recent address at the Ottawa convention, made a telling, and we believe a new point, in favor of the electric suburban road. His words were; "These railways will, I believe, go far to break down that isolation which makes country life so distasteful to the younger members of the community and may have a far reaching effect upon the great problem of how to attach the people to the soil."

There is hardly a question that the boys and the girls too, would be much better satisfied with the farm if they could get aboard a trolley train after supper and spend a few hours in town at the theater or enjoy some even less expensive recreation. President Dunstan's point will be well taken.

* * *

John Bull seems to be a little annoyed at the exclusive concession granted to Col. Spalding by the Hawaiian government for a cable connecting that island with the rest of civilization. He calls it a "grab-all," and intimates that the United States may not be permitted to carry out its dog-in-the-manger policy. The facts are that the Englisman has been beaten at his own game and he hasn't the good breeding to submit gracefully to a successful competitor in his own peculiar field.

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Mr. Merrill, in his interesting paper on fires directly and indirectly traceable to electricity, and which appears elsewhere in this issue, makes the sensible suggestion that a little knowledge is not always a dangerous thing, and cites as an example that a better understanding of what constitutes hazardous practice in electrical installations would save many thousands of dollars that now go up in smoke.

Our esteemed London contemporary the Electrical Engineer in its issue of September 6, reproduces from THE ELECTRICAL JOURNAL of August 15, an article on Street Car Propulsion written by Prof. Wm. A. Anthony, but neglected the usual courtesy of giving proper credit. We are charitable enough to assume that the ommission was due to an oversight and will not be likely to occur again.

If Chicago's public lighting and all other electrical equipments of a public nature are inefficient, as our good friend the Western Electrician alleges with a good deal of fervor, why is it that committees and commissions from all parts of the world are constantly sent to Chicago for pointers on prospective work? No dodging now, Brother Kreidler! Answer fair.

The street railway companies of the State of Massachusetts, by reason of a recent order of the Board of Railway Commissioners, anent electric heating of cars, are in a position similar to the unfortunate who is waylaid by a highwayman and ordered to hold up his hands. The chances of being robbed are about equal.

President Garlick, of the National Association of Stationary Engineers, is demonstrating that some engineers at least are not stationary by a good deal. His association is moving right along to the front rank of associations. We take the liberty to predict a great year for the N. A. S. E.

The article on Photometry, by Benjamin F. Thomas, the first installment of which appeared in our issue of August 15, and which has unavoidably been held over since that time, commences again in the present issue, and will continue without interruption until completed.

If the devoted subjects of Queen Victoria follow the example she has set them in refusing to use electricity in any of its forms about her own apartments, a share or two of Standard Oil stock would not be a bad thing to have.

Will the two submaxiliary gladiators, Prof. Forbes and Dr. Barker allow "time" to be called long enough for some of the rest of us to catch up with the "rounds?" We believe we have forgotten what it is all about.

New Yorkers have announced that any kind of "fender" will do now. Anything that sounds so much like "Defender" is currency in this country to-day—even in New York.

The St. Anthony Falls Water Power Company is making material progress with the construction of a dam across the St. Anthony river just above Minneapolis which in the near future will supply water power necessary to generate an electric current for almost unlimited use. Mr. C. A. Pillsbury is the originator of the idea and is largely interested in the company which is carrying on the work. Minneapolis with its large manufacturing interests will be greatly benefitted when the undertaking is completed and is fortunate in having within easy reach abundant and cheap power.

An average of 66.4 miles an hour was made over the New York Central, September 24, between Albany and Syracuse. The distance is 147.84 miles and the time occupied was 134 minutes and 30 seconds.

The name of the horseless carriage, till we make better country roads, is mud.—*New York Recorder.*

Does not the esteemed Recorder mean to say that so long as the name of the country roads is mud the name of the horseless carriage will be Dennis?—*Chicago Times-Herald.*

SAMUEL FINLAY BRESSE MORSE.

Mr. Morse is grandson and namesake of Prof. S. F. B. Morse, inventor of the electro magnetic telegraph now in use over the entire civilized world, and was born in Brooklyn, N. Y., November 24, 1852. He began his electrical career in 1872, at which time he assumed the management of the Eighteenth District American District Telegraph Office, at 516 Broadway, New York, under the old Theater Comique, this being the second office of the company opened for business. After this he became an operator at 195 Broadway, the main office of the Western Union Telegraph Company, and was transferred from there to the Erie Railway's lines between Port Jervis and Honesdale, Pa. Soon after that he took charge of the Western Union offices at Lebanon, Pa., which position he resigned in 1876 to accept a position with the Atlantic and Pacific Telegraph Company at the Centennial exhibition in Philadelphia, which he retained until the close of the exhibition. He then retired from the telegraph business and entered the banking business in Wall street, New York, and followed this until 1888, at which time he was made Vice-President of the Bulen Watch, Clock and Electric Company, at 265 Broadway, New York. He retired from this company, in 1890, and became the general western agent of the Eureka Electric Company, of New York, who were exploiting the Loomis system of incandescent lighting, with headquarters at Kansas City, Mo. During his term of office in this capacity, Mr. Morse took a special course in electricity and magnetism under Prof. Blake of the Kansas University at Lawrence, Kas., and passed his examination with honorable mention. Soon after that he came to Chicago as the general Western agent for Days Kerite wire and cables, which position he now holds.

Mr. Morse has a wide acquaintance in electrical circles and is probably the best known man in his line throughout the west and northwest. He is top and front at all conventions, making his influence felt everywhere by a genial, comradeship that leaves nothing to be desired. While he claims to have no camelian blood in his veins, he is able always to assume the color and character of his surroundings, which rare quality enables him to meet every man on his own ground. All in all, our friend Morse is about as Breezey a gentleman as we will find in a day's jaunt.

FOR THAT TIRED FEELING.

A Benzonia genius has invented what he calls an electric shampooer. It consists of a battery and induction coils placed under the barber chair, from which one wire is connected with the arm of the chair, and another with comb, brush or sponge in the hands of the barber. The person in the chair places his hand on the electrode on the arm of the chair, and the barber completes the circuit by brushing the hair. The current is supposed to clear out the head and produce a general feeling of exhilaration, especially if the subject has "been out all night." It is manufactured at Benzonia, and already there is a brisk demand for it.

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CANADIAN ELECTRICAL CONVENTION.

Fifth Annual Meeting held at Ottawa, September 18th—New Officers Elected—Brilliant Banquet.

In point of electrical development, Ottawa is probably the foremost city in Canada. It was therefore appropriatly selected for the fifth annual convention of the Canadian Electrical Association. The delegates were afforded much that interested them professionally and the meeting was made the most successful in the history of the society.

The convention was formally opened on Tuesday in the Tower Room in the House of Commons, when His Worship the Mayor read an address of welcome. The president having replied, adjournment took place until the afternoon, when the president, K. J. Dunstan, local manager of the Bell Telephone Company, Toronto, gave his opening address.

Notable electrical works and improvements during the year were referred to by President Dunstan. One of the most important electric railways opened for traffice during the past year, said he, was that known as the Hamilton, Grimsby and Beamsville railway, running from the city of Hamilton to Grimsby, a distance of about eighteen miles. It was not only the longest road of the kind in Canada, but was exceptional on account of the large amount of freight which it handled. He was informed that during June, July and August it carried 97,164 passengers and 559 tons of freight in addition to 2,917 cans of milk and a large quantity of fruit. A large fruit market had been established in Hamilton in connection with this railway. The advantages such a road afforded to farmers and fruit growers, and the value to Hamilton in being made the headquarters of the great fruit trade of a large section of the Niagara Peninsula were apparent.

As a result they now found similar electric roads projected or under construction in all parts of the country. These railways, he believed, would go far to break down that isolation which made country life so distasteful to the younger members of the community, and may have a far-reaching effect upon the great problem of how to attach the people to the soil.

"Last year," the president continued, "the Welsbach burner formed a slight unsettling element in all the lighting business, there being those who felt that the greater efficiency of the burner would, by cutting down the cost of gas, injuriously affect electric lighting interests. These fears have proved to a very great extent groundless, but we find this year a new disturbing feature in the form of acetylene gas, but to what extent it will become a live issue yet remains to be seen, as it is too early to predict the commercial outcome of Mr. Willison's cheapened method of production. The gas has defects which may prevent it ever coming into general use, but on the other hand it is possible it may become an important factor. Whatever the outcome, electric light men must face the fact that prices from competition or other causes, have a downward tendency and that the tendency must be met with improved methods of production."

Indications pointed strongly to their being on the verge of a "horseless age," an age when tricycles, carriages and a large proportion of vehicles in general will be self propelled. Tests had so far resulted greatly in favor of petroleum, but electricity had so many advantages due to freedom from dirt, smell and risk of explosion that the discovery of a lighter and more economical form of storage battery would enable electricity to control the trade, the magnitude of which was difficult to even estimate. The person who made this discovery would reap the greatest reward of the age.

DELEGATES.

President—K. J. Dunstan.

First Vice-President—Inspector Canadian Board Fire Underwriters, Toronto.

Second Vice-President—C. Berkeley Powell, Manager, Ottawa Electric Light Co., Ottawa.

Secretary-Treasurer—C. H. Mortimer, Publisher Electrical News, Toronto.

Executive Committee—L. B. McFarlane, Bell Telephone Co., Montreal; George Black, G. N. W. Telegraph Company, Hamilton; E. C. Breithupt, Berlin; B. A. Starr, Electrical Engineer, Montreal; J. J. Wright, Manager Toronto Electric Light Company; J. A. Kammerer, Royal Electric Company, Toronto; J. W. Taylor, Manager Ottawa Porcelain and Carbon Company; O. Higman, Inland Revenue, Department, Ottawa.

Montreal—W. T. Bonner, L. B. McFarlane, H. O. Edwards, D. N. McLaren, J. A. Burnett.

Toronto—A. M. Wickens, F. C. Armstrong, J. A. Baylis, W. B. Jackson, T. F. Dryden, J. H. F. Wyse, Joseph Wright, Charles T. Dwight.

Quebec—T. A. Bodfery; Rat Portage, Ont.—J. A. McGrossam; Port Hope, Ont.—V. B. Coleman; Peterborough, Ont.—H. O. Fisk, J. S. Knapman; Aylmer, Quebec—J. P. Brown; Brockville, Ont.—W. G. Gilmour; Arnprior, Ont.—R. G. Moles.

New York—F. W. Harrington, John H. Dale.

Ottawa—John Murphy, H. G. Roche, J. N. Thompson, A. A. Dion, George McDonald, C. Routh, H. Bott, D. C. Dewar, W. Y. Soper, William Borthwick, and D. A. Street.

The first paper read was one by Mr. C. P. Dwight, of Toronto, son of the president of the G. N. W. Telegraph Co. He dealt with "The Telegraph in Canada."

"Some Notes on the Consolidation of Two Systems of Electric Supply" was the title of a paper by Mr. A. Dion, based on the recent amalgamation of the electric lighting and power systems in Ottawa.

Wednesday afternoon Mr. D. R. Street, Ottawa, gave a paper on "Forms for Electric Light Accounting."

A paper, "From the Coal Pile to the Meter," by Mr. James Milne, of Toronto, was also read.

On Thursday H. T. Hartman, of Peterborough, Ont., read

A. B. SMITH,
President.

C. B. POWELL,
Vice President.

C. H. MORTIMER,
Secretary.

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his paper, "Some Modern Alternating Current Apparatus." The remaining papers were by D. H. Keeley, of Ottawa. "Non-Interference Duplex Relay" and "A Percentage Method for Circuit Measurements" were the titles.

Mr. George Johnston, statistician of the Dominion Government informed the delegates that there were over twenty-five million dollars' worth of material invested in electric railways and other electric appliances in Canada. The number of miles of electric railway in the Dominion was 868, as compared with 434 in the whole of Europe. During the past year fifty-seven million people had been carried on electric railways, while the steam railways only carried fourteen million.

A notable feature of the convention was the electrical display made at a banquet with which the local members entertained the visiting delegates. It was a most striking demonstration of the decorative possibilities of electric lighting. The delegates admitted that they had never seen anything that equalled it. The tables were in keeping with the other designs. There were confections to represent electric cars, dynamos and motors, and telegraph and telephone appurtenances. A well conceived electrical decoration was a representation of the Union Jack in red, white and blue lamps. Altogether there were over eight hundred lights in the room. The waiters had miniature electric lights in their shirt fronts, while from a floral arch over each chair a colored lamp shed its effulgence. To Messrs. W. Y. Soper and C. B. Powell is due the credit for the excellent display made.

The following officers were elected for the ensuing year:—

President—A. B. Smith, Toronto.

First Vice-President—C. Berkeley Powell, Ottawa Electric Company, Ottawa.

Second Vice-President—L. B. Macfarlane, manager Eastern Department Bell Telephone Company, Montreal.

Secretary-Treasurer—C. H. Mortimer, Toronto, re-elected by acclamation.

It was decided that the next convention be held in Toronto and in June, instead of October.

Mr. A. B. Smith, the new president of the association, has been identified with telegraphy for many years. He is superintendent of the G. N. W. Telegraph Company in Toronto and an electrical expert of the Fire Underwriters' Association of Canada. He was one of the originators of the Canadian Electrical Association, and was raised from first vice-president to president by acclamation.

Vice-President Powell is a son of the adjutant-general of Canada, and a director of the Standard Electric Company in Ottawa.

Secretary-Treasurer Mortimer is publisher of The Electrical News of Toronto.

During their stay in Ottawa the delegates saw the lumber mills in operation by electric light and the interior of the electric light and power houses. They were also taken for a sail on the Governor-General's electric launch. They were favorably impressed with what they saw at the power houses, which they agreed were the most complete in Canada.

SHALL WE SAY GENERATOR?

EDITOR ELECTRICAL JOURNAL.

Prof. Houston's Electrical Dictionary defines the word "generator" as "an apparatus in which electricity is produced by the mechanical movement of conductors through a magnetic field so as to cut the lines of force."

If I understand the matter rightly a so-called generator *is a collector* of electricity from the surrounding atmosphere, which is by nature charged with it, the commutator brushes acting as an agent for the collection of electricity. The wires attached to the respective poles of the machine are distributing mediums.

If a steam engine with a capacity of 100 horse-power were not provided with proper devices for the escape of the surplus pressure produced by the heat under the boiler, an explosion would follow, which is not the case with an electrical machine, capable of producing equal power, operated at full capacity, because the amount of power produced is indicated by the amount of resistance interposed in the circuit. If the term "generator" is correct, and there were no resistance or other means to utilize the power in the circuit and the machine were running at full capacity and "generating"—(as many have been led to believe)—100 horse-power, the heat thus produced would certainly consume the machine.

In experimenting with a machine capable of producing 3,300 volts and 28 amperes running at 750 revolutions per minute, the fields being separately excited by a machine of 220 volts and 8 amperes, the current thus produced being conducted to a transformer and the resistance entirely removed from the field circuit of the exciter I found that the only power consumed was about one-quarter horse-power, which was sufficient to counteract the friction; showing conclusively that the machine was not a "generator." But upon interposing a resistance in the circuit the machine immediately began to *collect* electricity and to heat the element of resistance.

Hence, I submit, that the term "electrical collector" would be more accurate and appropriate than the word "generator," and avoid confusion and perhaps serious error in the minds of the student of electric science. GEO. D. BURTON.

ELECTRICITY FROM CITY REFUSE.

NEW YORK, September 20, 1895.

EDITOR ELECTRICAL JOURNAL.

Gentlemen:—I was much pleased in reading in one of your issues of August, on page 100, headed "Electricity from City Refuse." You need not go to France, however, to get the necessary furnace for burning refuse to get steam power, whether for electricity or any other purpose.

We have a furnace now in operation in this city where we are burning from 16,000 to 18,000 pounds of combustible refuse, without the aid of any auxiliary fires. The heat from this furnace passes through a brick flue into a 100 horse-power boiler, which is blowing off constantly at 60 pounds pressure through a four-inch pipe, although supplying two engines and steam pump. We purposely left the boiler uncovered so it would radiate heat direct.

This furnace will burn the entire garbage output of the household, no smoke or smell from furnace, and does not require any skilled help. We have no difficulty in getting three (3) horse-power per each ton of garbage consumed in the 24 hours.

We do receive a great deal of cinder, consisting of broken glass, bits of brick and iron, in combination with the ash, but not sufficient to make it an object to save and grind up.

Yours very truly,

A. W. COLWELL.

THE TELEPHONE METER.

EDITOR ELECTRICAL JOURNAL.

Dear Sir:—The article headed "A Telephone Meter" in your last issue, although humorous, nevertheless gives expression to what must be the opinion of many users and non-users of the telephone. There are many householders and others who would use the telephone in a limited way, making only a few calls daily, and would gladly have telephones if the rates were more in proportion to the service they require. A meter to measure words is, of course, a commercial absurdity, but no one to register the number of connections, and to measure the length of time each connection is held, is both feasible and desirable. Who could predict the increase in the volume of business if small users could have telephones at the moderate cost of, say, $7.50 annually in small towns, $15.00 in cities and $25.00 in metropolitan centres! These rates to be chargeable where the number of conversations of average length, say two minutes each, did not exceed the average of five daily. I am informed that Romaine Callender, of the Decker building, New York City, patented some time ago, a telephone meter of this kind. The Callender Telephone Exchange Telephone system was described in your journal of issue date August 1. TELEPHONE USER.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students. Personal and Pertinent.

CLASS EXAMINATIONS.

Class examinations have been held since the publication of the list of September 1, in Elkhart, Ind., Cincinnati, Detroit, Joliet, Ill., Tesla class, Chicago, Edison class, Minneapolis, St. Louis and Fort Wayne, Ind.

Those who have received the required 70 per cent are as follows:

ELKHART, INDIANA.

C. E. Vallance,	J. H. Ludlow,
J. J. Jones,	Chas. F. Jacobson,
Chas. Towsley,	J. S. Lauby,
Wm. H. Ziesel,	J. C. Griffitts.

CINCINNATI, OHIO.

J. H. Creaghead,	Jas. E. McHugh,
Louis F. Kaiser,	M. H. Fletcher,
R. B. Evans,	Wm. Kleine.

DETROIT, MICH.

L. A. Weissenhagen,	Chas. G. Hampton, Jr.,
Benj. W. Clark,	Fred Todt.

JOLIET, ILL.

W. B. Lamb,	Andrew McNab,
	Karl Froedisch.

TESLA CLASS, CHICAGO.

C. A. Pitkin,	A. A. Cushman,
J. M. Lynn,	Saml. A. Cheevers.

EDISON CLASS, MINNEAPOLIS.

W. Kinsell,	A. G. Johnson.

ST. LOUIS, MO.

Edw. P. Ambler,	Wm. Brueggmann.

FT. WAYNE, IND.

B. Currier,	G. B. Taylor,
W. A. Brown,	F. B. Mensch.
	Chas. Yagerlehner.

Of these students the following received a per centage of 90 or more, and are hence entitled to the second or scholarship examination, time and place of which will be given to individuals:

C. E. Vallance, Elkhart..... per centage, 99
W. Kinsell, Minn..... per centage, 97
C. A. Pitkin, Chicago..... per centage, 95
J. J. Jones, Elkhart..... per centage, 93
Chas. Towsley, Elkhart..... per centage, 92
B. Currier, Ft. Wayne..... per centage, 92
Wm. H. Ziesel, Elkhart..... per centage, 91
J. H. Creaghead, Cincinnati..... per centage, 91
A. G. Johnson, Minneapolis..... per centage, 90
W. A. Brown, Ft. Wayne..... per centage, 90

In addition to these, the following members of the St. Paul class received 90 or over and are entitled to place in the above list, the markings having been received from the examiners too late to be included in the scholarship list in our issue of September 1.

J. H. Fitz..... per centage, 97
J. W. Shugard..... per centage, 97

REVISION OF THE GENERAL COURSE.

The lesson leaves for the general course of instruction have been undergoing revision for the year just now beginning. It has been thought wise by Prof. Jackson, who has had most of the revision in hand, to cut down the number of lessons to 35 instead of 45, as heretofore. This change will throw two lessons into one in some instances, and a sufficient number of specially simple lessons have been found to make such an arrangement advisable. The last lesson of the course, that on electro-therapeutics, has been elimenated, since there is now a complete electro-therapeutic course.

As the course is now arranged, it can be completed in a short school year, so that a class will not to have to carry their work through the summer. No matter has been cut out of the lessons, and the more important, and especially the harder lessons remain as short as they were before; changes in these being confined to the addition of such new matter as may have been added to the science since the lessons were first prepared eighteen months ago. The list of apparatus for the classes have also been revised, improved, and materially increased.

NEW BOOKS.

ALTERNATING ELECTRIC CURRENTS.—By Edwin J. Houston, Ph. D. and A. E. Kennelly, Sc. D. New York; The W. J. Johnston Company. 225 pages, 77 illustrations. Price $1.00.

The subject of alternating currents as heretofore treated in books has usually been considered too difficult for mastery by the general reader and those students who are not far advanced in mathematics. This book explains the principles of alternating currents by comparison with simple mechanical laws and by means of well executed diagrams.

Power in alternating circuits is very clearly defined, showing by diagrams why the product of E. M. F. and current does not equal the true number of watts when the current is out of step with the E. M. F. Numerous examples are given showing the use of the power factor which accounts for the lag of the current.

A chapter is given to the construction and operation of the commercial transformer, going into the details of both the mechanical and electrical construction.

Synchronous motors are treated briefly and the difficulties which oppose their general use pointed out.

Multiphase systems are discussed at length, armature windings and connections are explained clearly by means of diagrams. The monocyclic system which has been the cause of so much discussion recently is also treated in these chapters.

While this work is intended to be only elementary, accuracy is not sacrificed to make it easy to understand and those well advanced in electro technics can read its pages with profit.

This volume is the first of a series of ten which will take up electric heating, arc lighting, electro-therapeutics, etc., each volume, however, is complete in itself.

It is printed on a fine quality of paper, profusely illustrated and substantially bound in cloth.

ELECTRICAL MEASUREMENTS.—A Laboratory Manual. By Henry S. Carhart, M. A., LL. D., Professor of Physics, and George W. Patterson, Jr., M. A., B. S., Assistant Professor of Physics, University of Michigan. Boston: Allyn & Bacon. 344 pages, 142 illustrations. Cloth. Introductory price, $2.00.

This is a very well arranged text book and is an excellent laboratory guide. It contains only up-to-date experiments with modern apparatus. The user of this book is supposed to have completed an elementary course of physics and to have some knowledge of analytical geometry and calculus. Inantitative experiments only are given and only such as illustrate general methods instead of specific applications are selected.

The following subjects are treated in the order named: Definition of Units and their Dimensional Formulæ, Resistance, Measurement of Current, Measurement of Electromotive Force, Quantity and Capacity, Self-induction and Mutual Induction.

Appendix A, contains tables for the reflecting galvanometer and of doubled square roots for Kelvin Balances.

Appendix B, contains complete specifications of the ampere and volt as legalized by Congress in July, 1894.

The subject matter is well illustrated by cuts and numerous diagrams.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

A long distance telephone line is projected between Paris and Rome *via* Milan and Florence.

Telephones in use by the Japanese have two receivers, which are placed at both ears instead of one.

The eleven cables now in operation across the Atlantic have it is said cost upward of $70,000,000.

In Defiance, O., telephone rates have been reduced to $15 for business houses and $10 for residences. The reduced rates have been brought about by competition between The Northwestern Telephone company, just started and the Bell company.

The Old Time Telegraphers, at their recent meeting in New York, elected for the ensuing year the following officers: President, S. A. Duncan, of Pittsburg; Vice-President, J. D. Flynn; Secretary and Treasurer, W. J. Dealy, New York. The U. S. Military Corps, which met at the same time, re-elected their old officers.

The Chicago Telephone Company and Dr. Reilly, the city health physician, have come in conflict. The telephone company instructed its patrons to place their mouths close to the receiver of the telephone so as to make themselves distinctly heard, to which the doctor takes exception on the ground that the practice is dangerous to health by reason of infection from people who suffer from diptheria, consumption, fever and other similiar diseases.

London and Paris are connected by telephone and the charge for a three-minute conversation is eight shillings. There has been an agitation in London for a reduction of this rate to four shillings between the hours of 5 p. m. and 11 a. m., the hours in which the telephone is now in least demand. The Postmaster-General, however, says that the rate is an international agreement and cannot be changed without the concurrence of the Government of France.

The board of directors of the Central District and Printing Telegraph Company, of Pittsburg, have decided to reduce the time limit over their long distance telephone lines from five to three minutes and have reduced the rates about twenty per cent. The reason assigned is that by actual observation it has been found that the time consumed in the average conversation over the lines is about two minutes and that by reducing the limit to three minutes a cheaper rate can be given and but few people inconvenienced.

Light and Power.

Russian railway passenger trains are to be electrically lighted.

The reported consolidation of the six principal electric lighting companies of Philadelphia is denied.

Athens, Ga., will have the distinction of giving to Georgia the first cotton mill to be driven by electricity.

The loss by transmission of electric power from Folsom to Sacramento is said to have been reduced to 8½ per cent.

A new Russian canal, 1,000 miles in length, projected between the Baltic and Black seas, will be lighted by electricity, enabling vessels to traverse it in six days at the rate of about seven miles an hour.

Milwaukee is about to enter into a ten year contract for the lighting of its streets on the basis of $105 per lamp where the wires are in underground conduits, and $87 per lamp for lights fed by overhead wires, the lamps to be of 2,000 candle power.

A novel method of keeping an electric lighting company up to the scratch has been adopted by the council of Rutherford, N. J., when any light is found to be out and the company has been notified. If the matter is not immediately attended to a penalty of ten cents is imposed for the first night and fifty cents for succeeding nights.

The Queen of England is said to be a very determined opponent of the use of electricity, and to have forbidden its extension in any of the royal palaces, so far, at any rate, as the apartments frequented by herself are concerned, says the London Electrical Engineer. She is also adverse to the employment of electricity as a motive power for any purpose. The suggestion was recently made that the lifts, which have to be erected in every building occupied by her, should in some instances be actuated by electricity, but the suggestion was promptly rejected. Any hope, too, that may since have been formed as to the introduction of current for ventilating or for cooking purposes has now, it is stated, been entirely abandoned by officials concerned.

Railways.

An electric railway is projected between Toledo, O., and Petersburg, Mich., a distance of eighteen miles.

An electric street railway has been contracted for between Elkhart and Milford, Ind., by way of Goshen. The distance is thirty miles.

The trustees of the Brooklyn Bridge have instructed their chief engineer to investigate the question of using electricity as a motive power, and for switching of trains on the bridge.

Experts appointed to examine and report on the line and equipment of the Brooklyn Heights Street Railroad Company for the Flower syndicate and reorganization committee, reported that it would cost $1,000,000 to put the road in good condition.

New York state has about 1,400 miles of street railway track representing an investment of upwards of $200,000,000. During the past year they carried approximately 500,000,000 passengers as against the steam roads 160,000,000. The gross receipts of the lines are about $25,000,000.

The Brooklyn Heights Railway Company, whose cars have in the past been heated by coal stoves, will substitute electric heaters. An order has already been placed for 3,000, a number sufficient to equip 500 cars, six heaters being required for each car. Electric headlights will also take the place of the oil lamps formerly in use.

The first electric railway in Mexico is soon to be in operation in the state of Vera Cruz. This road will run from the city to Orizaba, a distance of about ninetv miles. The construction of the line is now in progress. It will pass through Coatepec, Jico and other towns in the rich coffee district of the state. General Frisbee is the owner of the concession for the road.

It is said the Illinois Central Railway will ask its stockholders for an increase in its capital stock of $10,000,000, and that one-half of this amount will be devoted to equipping the suburban portion of its line with electric appliances. The Chicago and Northern Pacific also are making preparations to establish an electric service which it is expected will be in readiness before the expiration of six months.

The common council of New Britain, Conn., gave to the Central Railway & Electric Company permission to extend its tracks through the city, imposing an obligation, however, that a certain tax should be paid to the city and that the cars should be equipped with fenders. The railroad company objects on the ground that the city has no right to impose such a provision and they have appealed to the courts.

Evidence is now being hunted up in Kalamazoo, Mich., to present to Judge Sage in the United States District Court of Ohio, in the interest of a patent claimed upon the application of electricity to street railway work. George C. Green, of Kalamazoo, as far back as 1879, claimed to be the originator of the electric street car idea, and applied for a patent on same. It was not until 1888, however, that he go it, and the delay so disheartened him that in the meantime he disposed of his interest to O. S. Kelly, of Springfield, O. The suit now pending is brought by the General Electric Company and Mr. Kelly against the Westinghouse Company for infringement and for a rendering of account.

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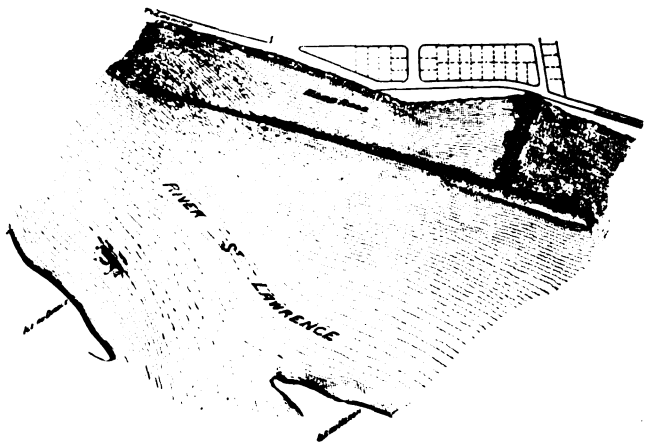
HARNESSING LACHINE RAPIDS.

An Important Application of Water Power for Electrical Purposes on the Canadian side.

What promises to be one of the most important applications of water-power for electrical purposes in the country, is now in course of construction at the Lachine Rapids near Montreal. At that particular point in the St. Lawrence, there is a very considerable fall in the river, and a very swift current, and the purpose of the present undertaking is to utilize the fall to generate electric power for commercial use in Montreal and its suburbs. Work has already been started and will be pushed to completion as rapidly as possible.

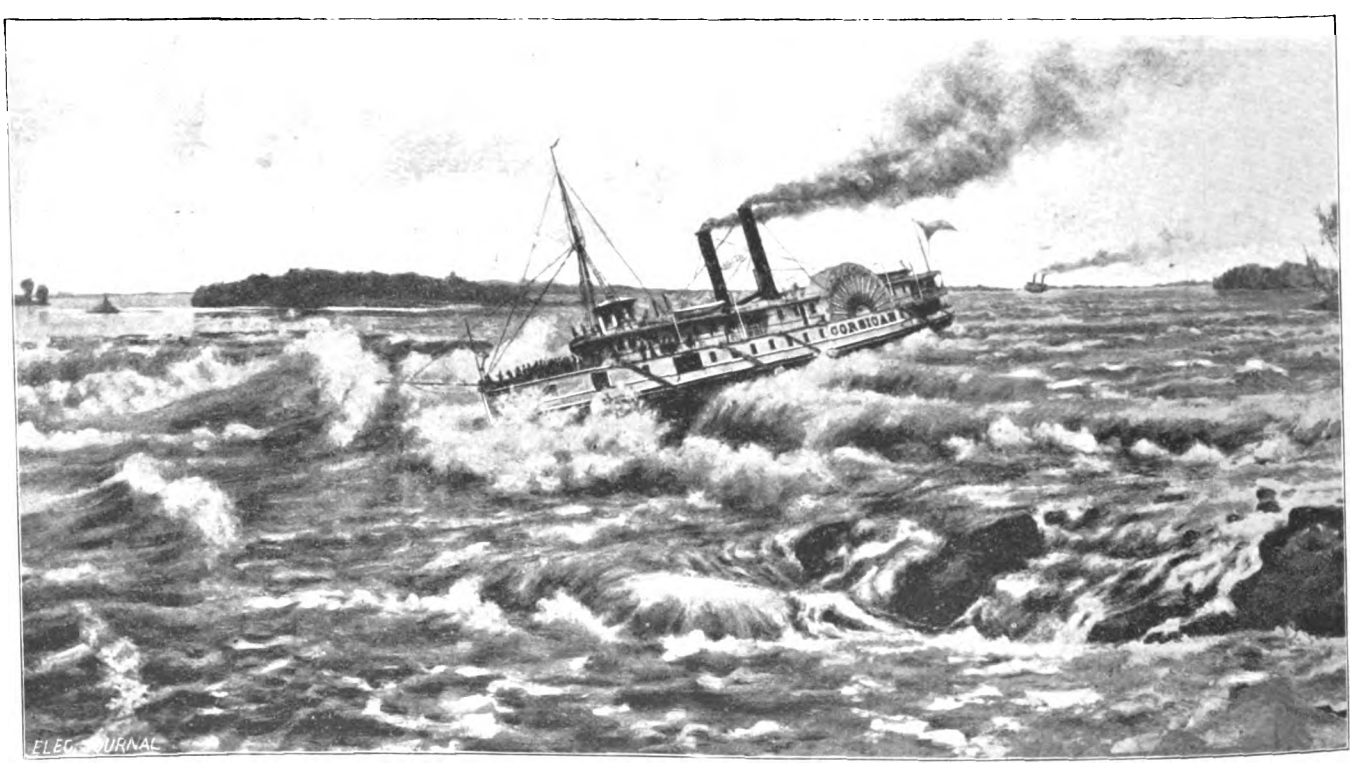
The wing dam as shown in the accompanying diagram will be 3,733 feet long, constructed of crib work and filled with boulders, with a cut stone ice fender at the upper end, and triangular piers sunk at six feet below water, to take up the fall that exists above the head-race. The main dam extends from the wing dam to the main land, some 3,500 feet below the ice fender, and consists of isolated piers of masonry, and made to form the flumes to take the turbine wheels and shafting which generate the power. On this main dam will be erected the dynamo houses, three in number. These will contain sixty-six large turbine wheels, working under a minimum head of eight feet; the shafting will be horizontal, and each generator or dynamo will be attached to six wheels by direct coupling, providing a total of about 8,000 horse-power. This power and more can be utilized readily in Montreal where electricity is coming into very general use for various purposes, among which one of the best electric street railway systems in the country, is perhaps the most important.



VIEW OF HEAD RACE AND DAM.

The work of construction is one of the largest undertaken in that part of the country for many years, necessitating in part the removal of some 230,000 cubic yards of rock now in the way of the wing dam, the construction of 3,500 feet of crib work, 20 feet wide and about 10,000 yards of masonry and concrete.

The enterprise is being promoted by W. McLea Walbank, civil engineer, and T. Pringle & Son, hydraulic engineers, backed by a number of prominent Canadian capitalists. A prominent engineering authority speaking on this subject, says: "The engineers have taken into consideration the action of anchor and frazil ice, and are satisfied that the means they have adopted in constructing the dams and head-race will be satisfactory and free from this trouble. Frazil, which is a great bugbear to all people having to do with water powers in Canada in winter, is never known to form in still water or under ice. As the proposed head-race will freeze over during the winter, it is believed no frazil will be formed in it. Therefore, only the frazil formed in the river above will have to be contended with. It is a well known fact, that ice, when it gets into still water, will float to the surface, and in this case the dams and head-races will be arranged so as to take full advantage of this physical condition, and that the power will consequently not suffer from it. Owing to the peculiar formation of the shore, and the position of the dam in regard thereto, the current tends to strike the dam at an angle with great velocity, due to the rapids above. The water approaches the head-race—which will be made of much greater capacity than would be actually required were there no anchor ice to contend with—at a very great velocity, and continues thus over the overflow of the dam, carrying with it the floating anchor ice. The water thus moving into the head-race at a slow speed, creates no suction and carries no anchor ice with it, the result being that a sort of water dam will be formed at the intake.



VIEW OF STEAMER DESCENDING THE LACHINE RAPIDS.

It is expected that the work will be completed by November, 1896.

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CAUSES OF ELECTRICAL FIRES.

Blame attached to Aerial Wires, Wooden Base Devices Sparking of Arc Lamps etc.*

During the past two years the electrical inspectors of the United States have co-operated in compiling accounts of the circumstances leading up to all electrical fires and burn-outs which have come under their observation. These accounts have been condensed and issued in the form of quarterly reports, so that all of the inspectors could receive the benefit of knowing what causes were producing electrical fires outside of their own territories. We have thus far on record accounts of nearly 1,000 such electrical fires. These do not, of course, represent the total electrical fire waste, because there are only about 40 electrical inspection departments in the country, and because so many fires destroy all evidences of their origin. Incomplete as they are, they nevertheless have the advantage of being wholly accurate, and of covering portions of the country having different climatic conditions and somewhat different practices prevalent in the manner of installing electrical systems. The aim in obtaining these accounts has been to secure an approximate comparison of the fires due to different electrical causes, and not to receive accurate accounts of losses. The detailed accounts given of fires, in which no loss resulted, have proven of greater instructive interest than the ones in which losses were paid, because the exact cause and conditions could be more accurately determined. Fires resulting in large losses generally destroy evidences of their cause, and but few large fires are included in the reports. Thus, for the first year the reports were collected, the total loss reported amounted to only $1,415,610.25. This, of course, gives no idea of the annual electrical fire waste, and can only serve as a known fraction upon which to base an estimate of the total.

It is not, however, to the loss account, but rather to the exact and specific causes of these fires that inquiry should be made, for it is there that the remedy can be found.

A comparison of causes among 815 electrical fires published in the first eight reports, shows that 113, or over one-seventh of these losses were caused by the crossing of telephone, telegraph and similar wires with trolley or electric light wires. Heavy current flows, established by such accidents through telephones, telegraph instruments and switchboards, always results in damage to these devices, and often times in their destruction, and the communication of fire from them to surrounding combustible material. The total loss due to these 113 fires was $324,957.50, which is a pretty large sum to charge to accidents which must be considered preventable.

Assuming then that a large percentage of electrical fires are caused in this manner, let us look for the remedy.

Removing conducting wires from exposure to the elements is the only absolutely certain way of overcoming all of the danger threatened by aerial wires, as it is the only cure which strikes at the root of the evil. By this means the chances of contact between wires of different systems is reduced to a minimum, and the hazard from lightning entirely eliminated. The cry, "bury the wires," has been successfully raised in many of the larger cities of the country, and laws and ordinances have been enacted requiring electric conductors of all, or of certain natures to be placed underground.

It would seem that the experiences of the larger cities in this matter would serve as useful examples to the smaller ones where electric equipments are growing at all extensive.

Almost without exception the movement to place wires underground has come after the poles and roof structures of a city have grown to such numbers as to be a mar upon the appearance of the streets. Then after a great amount of money has been spent in overhead construction the electric companies have been called upon to tear it all down and go to the additional expense of installing underground work. It will be seen that the entire original outlay could have been saved by using underground systems of distribution originally. The way in which history is repeating itself in different parts of the country in this matter ought to serve as a useful lesson to all managers of electrical enterprises whose business depends upon aerial wires, and the manner in which losses from this cause are accumulating ought to serve as a sufficient reason for every underwriter to miss no opportunity to oppose outside overhead electrical construction work, or to call attention to the advantages to be gained from a fire, life, or aesthetic standpoint from running electric wires underground. No great technical knowledge is needed to enable one to advance convincing arguments on the disadvantages of aerial wires and it will often be found that comparatively little influence is necessary to start such a movement along the road to success.

Many of the cities of the West offer fruitful fields for work of this kind and a little of the time of every field-man could be profitably spent in agitating the subject when opportunities present themselves.

In country districts where the cost of underground electrical construction would be prohibitive, care can be exercised in providing guard wires and in installing protective devices where battery wires enter buildings, but these are perhaps matters to be treated by the electrical companies and the district inspector rather than the field-man.

It is unfortunate that trolley companies have installed their roads in so many places without any regard to the telephone or telegraph wires running above them and that telephone companies have been so backward in designing and installing efficient devices to place in their lines for the protection of their instruments. Like a great many other admirable and perhaps necessary things the item of expense nas held back improvements of this kind though the outlook for obtaining respect for other people's rights in this particular from these corporations becomes more hopeful as accidents to life and losses by fire, due to this negligence on their part, become more numerous and apparent.

Such occurrences as the following, for instance, tend occasionally to divert attention to the subject:

Fire No. 712.—"Cross between telephone and trolley wire. Pole on the trolley car raised the trolley wire so that it came in contact with a telephone cable stretched above it. Forty-two of the seventy-five telephones connected to the exchange were burned out and the switchboard wrecked."

Fire No. 479.—"We had a severe storm here on the 26th which played havoc with overhead wires on the streets. A large number of the telephone company's new distributing poles, 90 feet in height, and 18 inches in diameter, were broken, and fell, letting down wires in all directions. Together with this, nearly all overhead wires were disabled and crossed with electric light and trolley wires. The trolley railways were interrupted for several hours; ten horses were electrocuted in the streets; hundreds of telephone, telegraph, and fire alarm signal boxes were burned out. Singular to say only two fire losses were reported. The origin of one of the fires was plain to be observed and is suggestive. A high tension current was conducted over a burglar alarm wire into a building, and at the point where the wire was grounded on the gas pipe the current pierced a hole in the pipe and ignited the escaping gas which set fire to the surrounding woodwork. Damage about $50."

Next in importance to aerial wires comes wooden base devices, that is, electrical switches, cutouts, and uninsulated current carrying strips, bars and connections of all kinds which are mounted directly on woodwork instead of on porcelain, slate, marble or some such non-combustible material.

Wood used for bases for such devices is responsible for 67 or one-twelfth of the 815 fires given in the first eight reports, and for a total loss of $116,027. Under this heading is not included wooden cleats or similar supports which come in contact with the insulated covering of a wire. By wooden base devices are meant only such as have bare current carrying parts mounted directly on woodwork.

*Paper read by W. H. Merrill, Jr., before the Chicago meeting of the Underwriters Association of the Northwest, September 26.

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Burnouts from this cause are very numerous and I know the reports show but a very small fraction of the total troubles from this cause as hundreds of them result without loss. Exactly why it was ever supposed wood was a proper material for mounting electrical contact devices on I cannot explain. The extreme readiness with which electricity is daily demonstrating the dissipation of energy, coupled with the fact that wood will burn should long ago have shown the manufacturers that electrical devices must have non-combustible bases.

Fortunately to-day the manufacturers have nearly all learned this lesson but unfortunately for the insurance interests they sold a great amount of material before finding it out and they didn't give a ten years guarantee with any of it.

On account of this mistake of the electrical manufacturer the insurance field-man must remember that where risks are equipped with wooden base cutouts, switches, hanger boards for arc lamps, rosettes, and similar appliances, that a fire will result just as soon as a loose connection is established to generate heat enough to ignite the wood.

And so the record runs through specific causes, such as sparks from arc lamps, heating effects of incandescent lamps, and over heating of wooden encased resistance devices, and through general causes due to defective systems such as the operation of lamps and motors by current supplied from trolley wires and the many troubles which lead up to break-downs in transformers and result in conveying pressures of 1000 volts on to interior wiring systems designed for 50 or 100 volts. The total cost of these happenings to the insurance companies may be $3,000,0 0 or may be $5,000,000 annually.

We have proved that it is over $1,500,000, and we know that whatever the total may be it is altogether too large and that greater effort should be made to prevent it by the electrical manufacturers, the lighting companies, architects, municipal authorities, the public generally, and the insurance companies.

We have recently found an easy and effectual way of enforcing complaints against the manufacturer by the formation of the Electrical Bureau of the National Board under whose direction defects discovered in any electrical device are portrayed in pictures and words and the reports distributed to the various insurance associations and companies of the country, and other people interested. This always leads to improvement in the manufactured article. The lighting companies always will be troublesome because there are so many of them so widely distributed, because they all wish to sell current, and because they find it easier to obtain custom if the cost of installation is cheap. There are a few exceptions to this rule among companies supplying currents who do not do construction work, but many of them, like the majority of the electrical contractors of the country, do not consider good practice or the safeguards necessary to prevent fire other than as decided hindrances to what they are pleased to consider their legitimate business.

The architects from necessity are becoming more or less informed on electrical matters and some of them have the good sense to employ specialists in this field. Slowly but surely municipal and state authorities are seeing the necessity of exercising supervision over electrical installations and the number of municipal electrical departments increases every year. The people generally, or such of them as secure a common education will eventually, of course, take this matter into their own hands and of their own knowledge prevent the frauds perpetrated by electrical contractors and the installation of a good deal of unsafe wiring.

Electricity is becoming so common to our everyday life that the schools must teach its laws, and therein lies the true solution of the problem. I am afraid there will never be much to hope for from people like our friend in fire No. 701, who, upon retiring to his room in a hotel, attempted, through lack of familiarity with the apparatus, to blow out an incandescent electric light. Failing in this, he wrapped a towel around the lamp and went to bed. Sometime in the night the heat from the lamp ignited the towel, and the gentleman was taken from the room by the firemen in an unconscious condition, having been partially suffocated by the smoke.

To such of the populace as live in cities, however, electricity is becoming daily more common, and two or three generations hence we may hope to see the occupants of some of our mercantile buildings intelligently doing their own wiring.

The insurance companies have done a great deal towards informing the public on electrical matters, and it is certain that they can economically do more with beneficial results.

A little knowledge is not always a dangerous thing, and each one of you could perhaps pick up something in this line which it would be well to tell your neighbor, especially if he is insured in your company and is using electricity.

If everyone could only know and appreciate the facts that wires ought to be underground, that wooden base electrical devices are poor things to have around the house, that arc lamps give off sparks, that incandescent lamps get hot, that wires should be kept free from grounded pipes, and the other useful little lessons that these electrical fires teach us, how much better your loss accounts would appear.

The insurance men throughout this great Northwest are certainly competent to learn and repeat some of these mottoes, and I am certain that if they all would attempt it a great amount of benefit must ensue.

LEAKS ALONG THE LINE.

A London restaurant serves its food on electrically heated plates.

The Western Electric Company is making an addition of three large new fire proof buildings to its plant in Chicago. The cost will be about $150,000.

The Colorado Automatic Telephone Company has recently been organized at Colorado Springs to operate a Strowger automatic telephone exchange.

The Metropolitan Electric Company reports an improved demand for their P. & B. insulation compound; indeed they state that their trade in that particular line has never been so good as now.

Frank Judson Pope, son of Ralph W. Pope, has entered the field of journalism with a view of making it his life work. He has just graduated from Columbia college and in getting on the staff of the New York Evening Sun starts out under favorable auspices.

The Keystone Electric Company of Erie, Pa., have contracted to furnish the electrical equipment necessary to operate the immense pumps being erected by the Apollo Iron and Steel Company near Pittsburg. These pumps will be required to deliver 17,000,000 gallons daily.

The Western Society of Engineers held its last meeting September 24 in Science Hall, Armour Institute of Technology. A paper was read by Ambrose V. Powell on "Some Notes on the Dry Docks of the Great Lakes." As the result of a letter ballot it was decided to withdraw from the Association of Engineering Societies.

The Metropolitan Electric Company is preparing a handsome 700-page illustrated catalogue, which will be one of the finest and most complete books ever issued by the electrical trade. There has been a little delay in getting it out, owing to the addition of many new articles that have been added at the last moment, but it is hoped now to have it ready for distribution right after October 1.

Telegraphers are alarmingly subject to consumption, according to the British Medical Journal. Out of 100 deaths among all adult males in England 13.8 are due to consumption; out of 100 deaths among the grinders in the cutlery trade who are specially subject to the disease, 33.1 are due to it, while the proportion for the telegraph operators is 46.6 in 100. More than half of them die of diseases of the respiratory organs, against 24 per cent, only in all other occupations.

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THE TELEPHONE NEWSPAPER.

A Vienna correspondent of the London Electrical Engineer who recently visited Budapest, furnishes some particulars concerning the Telephone Hirmondo, or Herald, which has now been working, apparently successfully, for over two years in the Hungarian capital, although when the conception was first mooted the idea encountered considerable ridicule. "While I was dressing in the morning," the correspondent relates, "the hotel servant knocked at my door and asked if I wanted the telephone paper. He then handed me two receivers about the size of a pocket watch, attached to long cords, which can be fastened to the bed or arm-chair to suit one's convenience. 'The newspaper will begin to speak directly,' remarked the servant, 'and will go on speaking until late in the evening. We don't charge our visitors anything for it, as it only costs us a penny a day.' Though only lately introduced, the telephone newspaper has become almost indispensible; it is to be found everywhere in this capital, and not only in places where persons require amusement or distraction, as in doctors' waiting-rooms, at barbers' shops, coffee-houses, restaurants, and shops of all kinds, but also in the offices of merchants, bankers and lawyers, in hospitals and private houses, for the use of aged people to whom reading is fatiguing. It speaks all day, but does not give the news in a chaotic jumble, but minute by minute. It is imparted in strict accordance with the programme received by each subscriber. In this way each person knows when the turn will come for the news interesting to him. It was half-past eight when I put the receivers to my ears, and the day's work commenced for the newspaper. It began by transmitting the telegrams received in the night from Europe and America in a clear sonorous tone, quite free from the nasal twang of the ordinary telephone. This went on till a quarter to nine, after which followed the daily calendar with metropolitan news, and the list of strangers who had arrived at Budapest up to the previous night. At nine, official news, contents of the official gazette, etc., were given. From a quarter to ten until a quarter-past ten came a review of the Vienna and Budapest morning papers; from a quarter-past ten to half-past ten reports on the opening of the stock and corn exchanges; from half-past ten to eleven local and ecclesiastical news, with theatricals, art and science notices. A quarter-past eleven to half-past eleven brought foreign, provincial and sporting information; and from half-past eleven to a quarter to twelve reports arrived from the Vienna stock and corn exchanges, with all sorts of military, court and political items. Early in the afternoon, when the sitting of the Reichstag begins, the parliamentary report is supplied every 10 minutes. The office is in telephonic communication with the Reichstag, and it often happens that important speeches from ministers and members are known to the public while the speaker is still addressing the house. In this orderly way the programme is carried out until late in the evening. The latest reports from the stock exchanges, as well as foreign political news, are heard before any paper has printed them, and a short summary of all important items is given at noon, and again in the evening, for those who may have missed any of them. Music, art and literature play an important part in this telephonic organ. Towards evening, when news is growing scarce, the subscribers are entertained with vocal and instrumental concerts, quartettes and solos—the latter given by the most talented artists of the capital. The National Theater is now within the circuit of the journal. The telephone newspaper abhors politics; it gives no leaders, only strictly chronicling in an impartial manner the opinions of other papers. It gives, however, original literary articles or feuilletons, and the latter, when written by some such favorite author as Maurus Jokai or Victor Rakosy, are frequently spoken into the telephone by the author themselves, either from the editorial office or from their own desk telephone at home, placed for the purpose of communication with the office. This novel kind of lecture is heartily appreciated by the feminine public. All these benefits are showered upon the public for 1d. a day. Both wire and apparatus are conveyed free of expense to the subscriber's house. He is only under the obligation to subscribe for one year. The company started with a capital of 300,000fl., and have thus far invested 500,000fl. in the concern. The organization of the staff resembles that of any other big paper. Ten men with strong voices and clear articulation act as speakers, and take their turns in shifts of two at a time. One of these speaks a series of items, but for no longer than eight or ten minutes, and every new item is introduced by the word 'new.' An emergency signal has lately been contrived by M. Szvetic, the head of the technical department. A shrill trumpet-like blast, audible in the whole room without connection with the receivers, sounds from both of them, warning the subscriber, if he be not at the time listening to the news, that an important event is about to be read. The 6,000 subscribers are served by one wire, measuring 168 miles in length, and running along the windows of the subscribers. Each subscriber forms a 'station.'" The founder of the Telephone Hirmondo, Theodor Albert Puskas, was a native of Transylvania and a friend of Edison. He had, it appears, an adventurous career. He at one time obtained from the municipal authorities of Antwerp an authorization for the establishment of a telegraphic newspaper to be issued on the same basis as the later-conceived telephonic journal. He started the Hirmondo on February 15, 1893, and he died on March 16 of the same year at the age of the age of 49.

ELECTRIC CONDUIT SYSTEM.

Mayor Swift, of Chicago, while visiting in New York, took occasion to look into the operation of the underground electric street railway system. In an interview upon his return home he said:

"While in New York, I took special pains to examine the working of an electric conduit system on the Lenox avenue line. This line, which is about four miles in length, has been in operation about six months, and is an unqualified success. In the construction of this system all objection to dampness and its attendant drawbacks have been removed and it is actually more reliable and certainly less unsightly and less dangerous than the overhead wires. While it has not yet been tested by a winter season, there is no reason to doubt its ability to stand all changes of weather. The cars are easily governed, practically noiseless, and can be run at any desired rate of speed. The same kind of system has been put in use in Washington, where it has successfully met every test. There is no longer any doubt as to the practicability of the system even in Chicago. The trouble is that the railway companies do not want to go to the expense of making such lines. The underground system, as applied in New York and Washington, costs about $40,000 a mile, while the present overhead trolley system can be constructed for about $8,000 a mile. The companies, therefore, have 32,000 reasons per mile for clinging to the over head trolley wires."

CHARACTERISTIC SCOTCH THRIFT.

The closeness with which minor expenses are watched in Scotland is shown by the careful figures in regard to the city lighting plant of the Edinburgh Corporation. There are about 150 arc lights now run from its efficient central station, and the illumination of historic Prince's street in this modern way is accounted one of the glories of the Scottish Athens. The turning out of these lights, which are on the same mains as the incandescent lights, is done by hand. The time formerly occupied was nearly two hours, when the attendant went around on foot. But a man is now sent on a bicycle and does the work in half an hour. The corporation is characteristically pleased to find that by thus lessening the time of unnecessary use of current and consumption of carbons, it is saving $200 worth of electricity every year. It may be mentioned that the Edinburgh plant, which combines high and low tension current with the use of accumulators, has already no fewer than 20,000 incandescent lamps connected.—*New York Post.*

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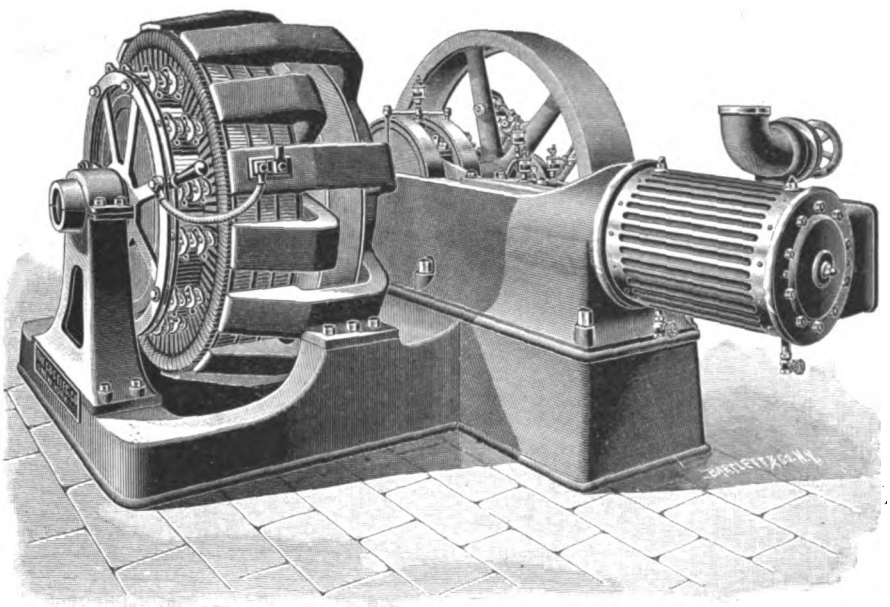

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FROM OCEAN TO OCEAN.

San Francisco, Cal.—Wm. G. Lawrence, engineer in charge of the exhibit of *Fort Wayne Electric Corporation*: At the California Midwinter International Exposition, 1894, I made a trial of your brushes on the Wood alternating current dynamo and exciter. The brushes and commutator ran cool, free from sparks, and with a good polish.

THEY KNOW

New York.—Interior Conduit & Insulation Co., Chas. S. Pease, Supt.: We take pleasure in recommending your Dynamo Brush after an extended test. We find it satisfactory in all respects.

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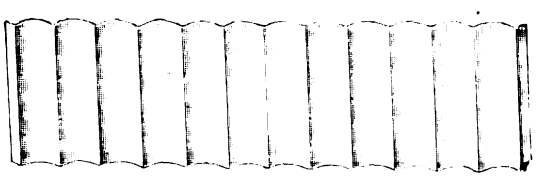

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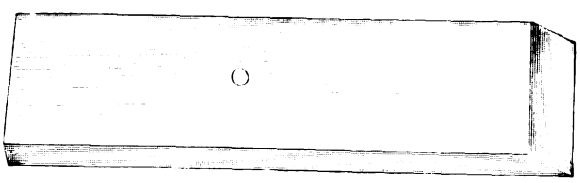

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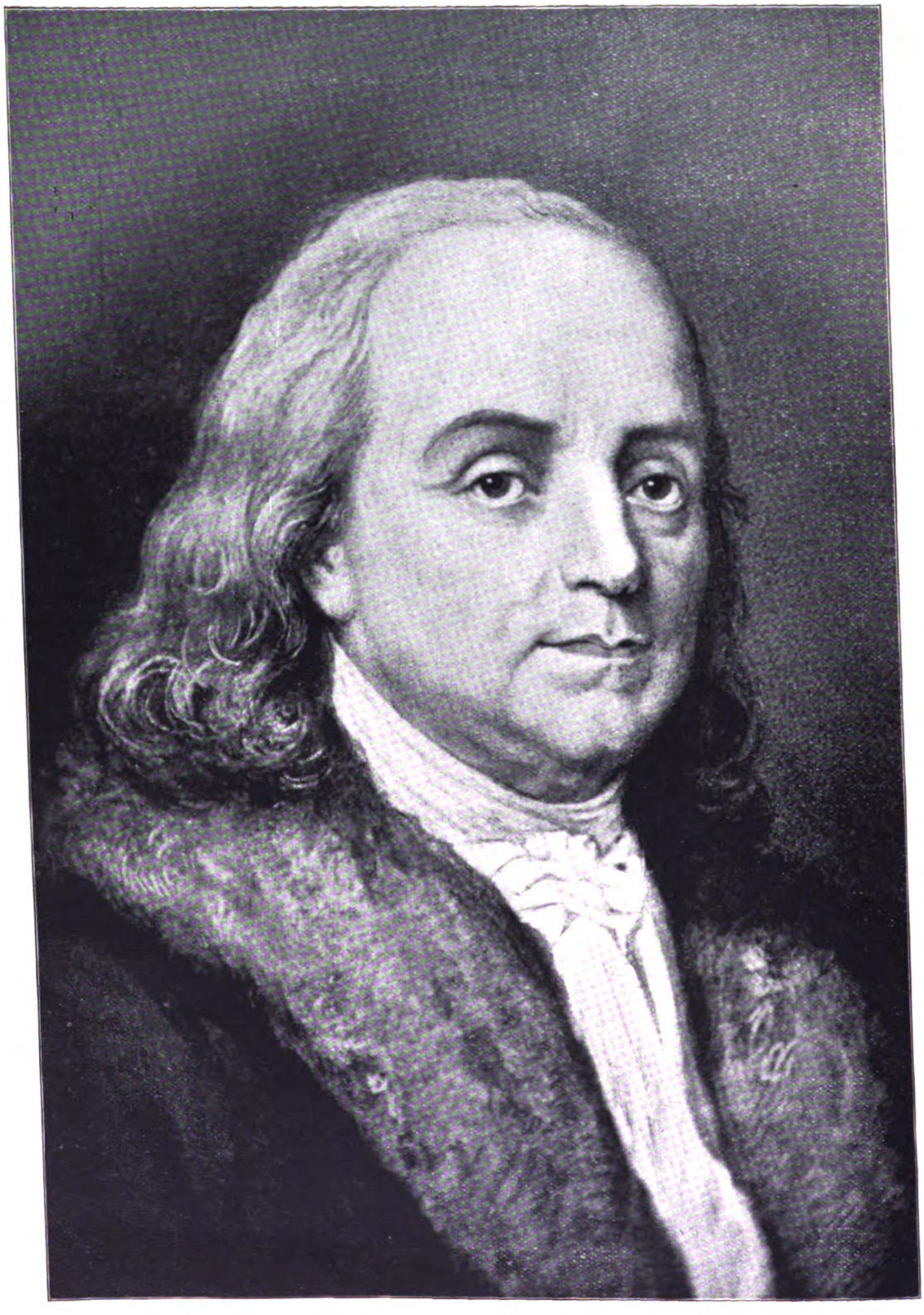

BENJAMIN FRANKLIN.

Journalist, Diplomat, Statesman and Philosopher. Born at Boston, 1706. Died at Philadelphia, 1790. First discovered the identity of Electricity with Lightning. Inventor of the Lightning Rod.

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The Electrical Journal.

Vol. 1. CHICAGO, OCTOBER 15, 1895. No. 10

THREE-PHASE ROTARY FIELD.

An Experimental Study by Messrs. Hansen and Webster of the Rotary Field of a Commercial One Horse-Power Three-Phase Induction Motor.

MAXIMUM VALUE AND ROTATION UMIFORM.

Eighteen months or more ago some measurements of the strength of the magnetic field of a three-phase induction motor, were made in the electrical laboratory of the University of Wisconsin by Messrs. Hansen and Webster. It is a difficult matter, for various reasons, to measure the exact strength and distribution of the magnetism set up by the field windings upon an induction motor when it is running, but if it were possible at any desired instant to freeze the magnetism in place the measurements could then be readily made by various methods. Fixing the rotary magnetic field in place is, of course, not possible, but an arrangement which may be considered as practically equivalent may be gained by passing continuous currents of proper value through the three field circuits. To represent sinusoidal three-phase currents the arrangement of the circuits must be such that the algebraic sum of the three currents is zero and the currents must be at every instant respectively equal to $a \sin = x$, $a \sin (x + 120°)$, and $a \sin (x + 240°)$ where a is the maximum value of the current and x is the phase angle. The strength of the field at different phases of the alternating currents can be represented by adjusting the currents to different values. In the tests here described a coil of wire was placed on the surface of the armature core which covered about ten degrees of the periphery. When the armature core is stationary such a coil may be considered to embrace the same number of magnetic lines of force as would be embraced by two inter-connected armature conductors placed at ten degrees apart. By measuring the number of lines of force passing through the coil when it stands at different points, the strength of the field all around the armature may be determined, and the variation

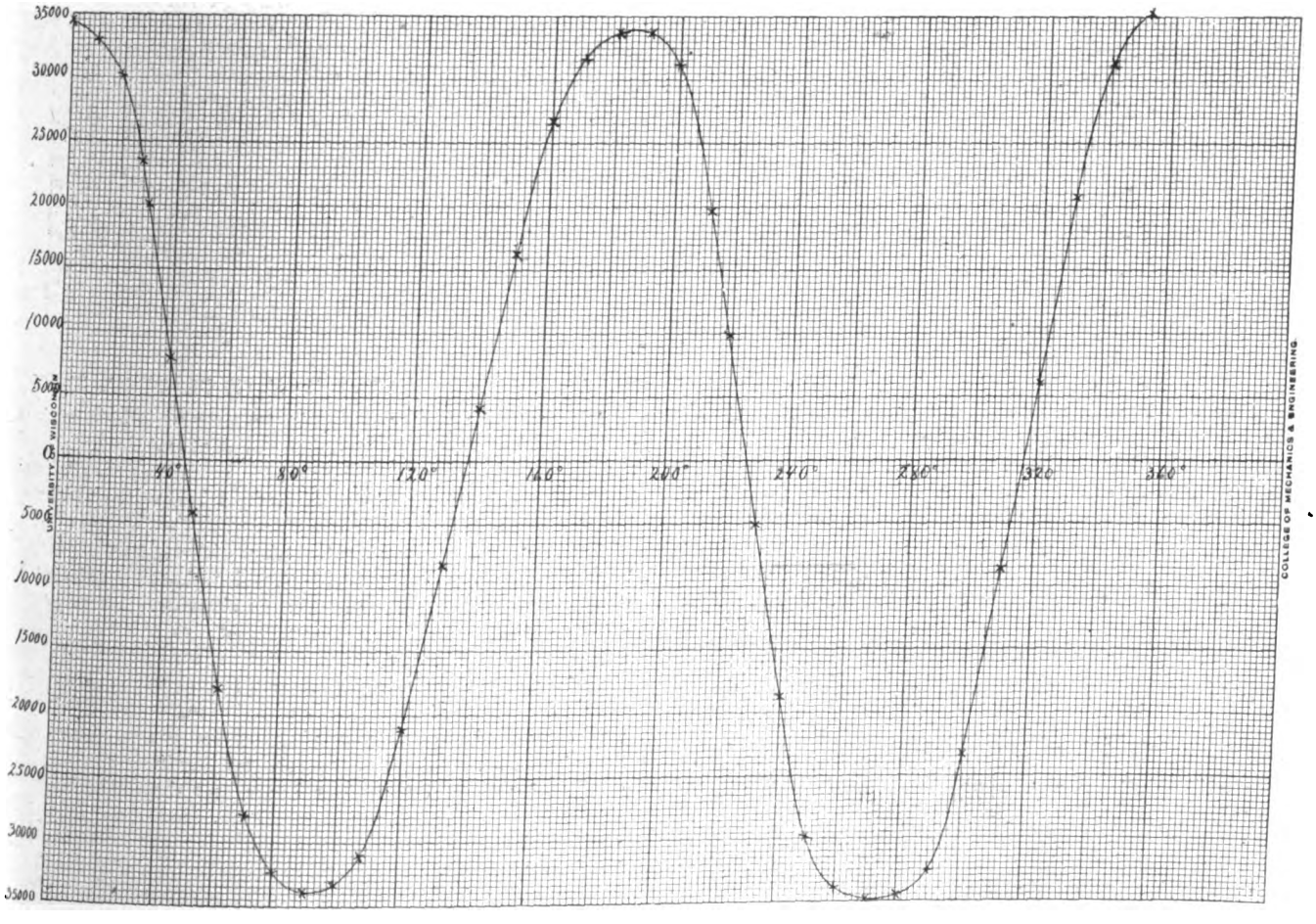

FIG. 1.

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of the strength of the field at any one point, with magnetizing currents representing different phases of the alternating current may also be measured.

The measurements made by Hansen and Webster included experiments as described above, and their results are shown in the accompanying curves, Figs. 1 and 2. Fig. 1 shows the magnetism passing through the coil with the magnetizing currents at a fixed value, measurements being made with the test coil in 36 different positions ten degrees apart. The ordinates of the curve represent lines of force and the abscissas appears. This would go to show that, in the motor tested, the maximum value of the rotary field is constant when the windings are supplied by sinusodial currents in three phases, 120° apart, and no armature reactions interfere. The apparent rotation of the maximum poles of the field also appears to be about uniform.

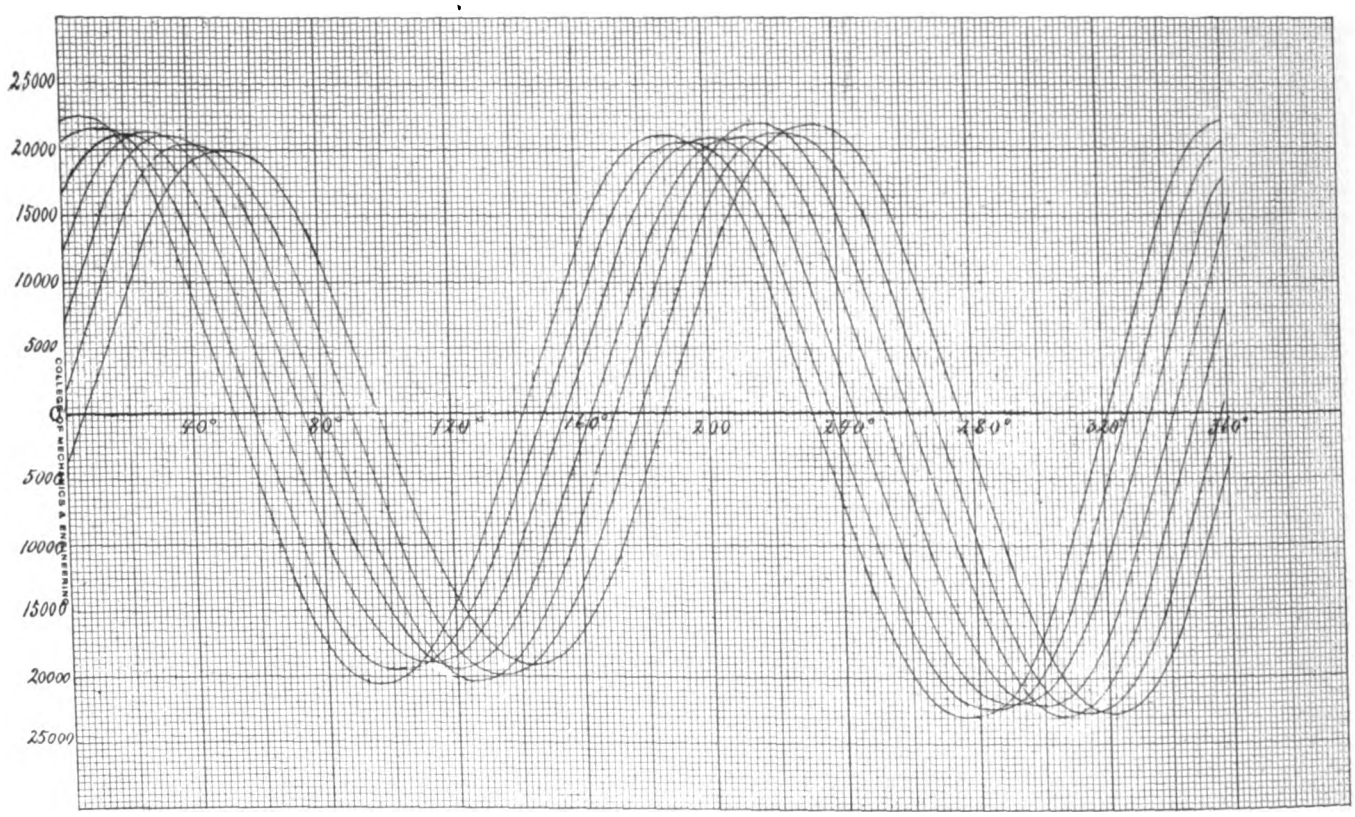

FIG. 2.

represent the corresponding coil positions. It will be noticed that the curve is quite similar in form to a sinusoid. As the motor has four poles this curve has two positive loops and two negative ones. Fig. 2 shows a series of similar curves taken with the currents in successive phases fifteen degrees apart. Fig. 3 shows the curve of magnetization of the motor upon

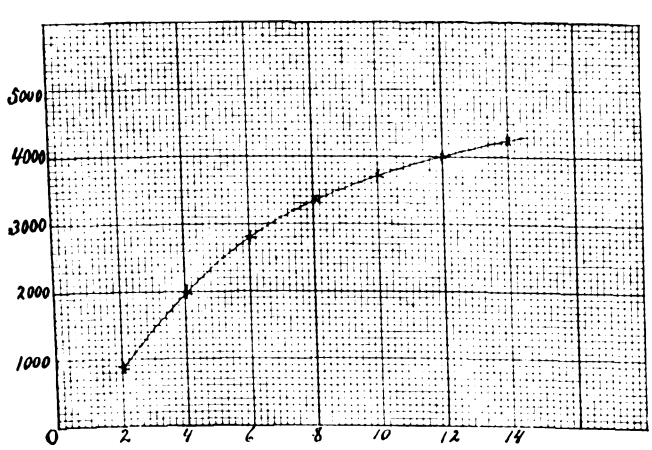

FIG. 3.

which the measurements were made. The maximum values of thedifferent curves shown in Fig. 2 are very nearly equal, in fact the differences are within the experimental errors of the measurements, and no particular order of the inequalities

HOW TO COVER PLATINUM WITH PLATINUM BLACK.

It is sometimes very desirable to cover a platinum surface with adhesive platinum black, and the chief trouble experienced is to make the finely divided platinum, composing the platinum black, adhere strongly to the surface. I believe the usual way is to deposit it from platinic chloride.

In the course of some electrolytic work nearly a year since, I happened on a method by accident, which, though not absolutely new, is not generally known even to chemists. A nearly saturated solution of zinc sulphate was electrolyzed between platinum plates with a current of one-tenth of an ampere for about six hours, or perhaps longer. About 100 sq. cms. of sheet platinum were exposed at either electrode. After the electrolysis was concluded, the cathode plate was, of course, covered with deposited zinc. This plate was left standing in the zinc sulphate solution for about twenty-four hours. At the end of this time the surface of the platinum on which the zinc had been deposited was found to be covered with a firmly adherent coating of a very black substance, which proved to be platinum black. It adheres so firmly that I have not yet succeeded in removing much of it.

The secret of the operation seems to be, that the zinc, when slowly deposited, amalgamates with platinum; and, on dissolving it out, the platinum on the surface is left in a very finely divided state. It adheres persistently because it forms a part of the surface and has not been simply applied.

Henry S. Carhart

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PATENT OFFICE HANDICAPPED.

Congress is a Stumbling Block in the Way of an Efficient Administration.

Having read several articles in the late issues of your journal bearing upon the method and mode of practice in the United States Patent Office condemnatory thereof, permit me to state that I have had granted to me within the past twenty years more than 300 patents, and I am therefore somewhat familiar with the practice of the office.

I find that one of the important and immediate requirements of the Patent Office is, more commodious quarters and better paid officials. As I understand it, the Patent Office has to its credit in the United States Treasury nearly one million dollars, which can only be used by the office for its necessary monthly expenses, and in order to use any portion beyond the actual expenses for any betterment or improvement in expediting the practice or to improve the facilities, therefore, it must be done by a special act of Congress. Therefore the Patent Office is prevented from using the funds which have come into its possession through the medium of the inventors of the country for any improvement actually necessary and required. The South and the West being opposed to the patent laws of this country and to patents generally, when any measure is introduced in either House or Senate looking toward the improvement of the system, it is fiercely opposed and defeated.

The Patent Office building was designed and constructed especially for Patent Office purposes and for the display of the many of the various models and inventions, yet thousands of them are stored in nearby lofts, covered with dust, cobwebs and spiders. The better part of the office room has been taken by the Land Office and the Department of the Interior. The Examiners rooms are overcrowded, uncomfortable and insufficient in capacity and the valuable documents of record are now found piled about the corridors of the building in almost hopeless confusion. The Present Commissioner, Hon. John S. Seymour, since his appointment to office, has done much to improve and expedite the method of practice, and within the inadequate space has done remarkably well and sufficient in the estimation of the writer to place him upon the list of successful Commissioners of Patents. He has made many changes and valuable decisions.

What the inventors of this country should demand, and what they can get if demanded collectively, is a suitable building for the sole use of the Patent Office; comfortable quarters, well-paid officials and sufficiently well paid; so that after having become familiar with the practice of the office, that their salary will warrant them in remaining in permanent position. The money has been placed in the United States Treasury through the medium of the inventors of this country, and it belongs to them to say and to demand its expenditure in a manner which will enable them to receive prompt action upon their applications and upon all matters of interest to them which may properly come before the United States Patent Office. Congress has treated the inventors of this country in a niggardly and gingerly manner, and it behooves the inventors to rise in a body to demand that to which they are rightly and justly entitled. And if the present Congress does not deem the interest of the inventors of that importance to merit consideration, let us see that we send to the next Congress representatives of broad and ennobling instincts, who have our interests at heart, and agree with us that we have a voice in suggesting as to what our rights are, by calling upon them to make a judicious expenditure of our money for the improvement of the facilities and betterment of the practice. The Commissioner and his subordinates being hampered in the expenditure of the funds rightfully belonging to the office, but little can be expected of them beyond the usual and long time practice and method.

Very respectfully,

GEO. D. BURTON,

Subscription price to THE ELECTRICAL JOURNAL is $2.00.

MUNICIPAL LIGHTING.

The Argument Denied that it Affords Politicians a Chance to be Crookeder than Usual.

Mr. Toulin, a member of the Board of Public Works of Springfield, O., has been collecting some data as to the municipal ownership of electric light plants in the United States, says the Leader, of Pittsburg. Mr. Toulin says he has found that fifty cities which use the electric lights furnished by private companies on contract pay on an average $114.58 per light per year. On the other hand, statistics show that fifty cities which own their own electric light plants have to pay on an average $57.88 per light for a year. The difference between the two figures is just $56.70.

He says that Pittsburg pays $96 per year for each light; that Cleveland, which has its lights furnished by contract, is charged $88; South Bend, Ind., has its lights furnished for $70; Peoria is charged $90; Des Moines gets its lights for $72. Other figures are Racine, Wis., $80; Quincy, Ill., $75; St. Louis, $75; Cincinnati, $84; Indianapolis, $85; Louisville, $94; Canton, O., $70, and Scranton, Pa., $91.

Taking up those cities which furnished their own light, he finds Chicago, with 1,000 lights, paying only $100 a light, and then renting them for $137.00. Easton, Pa., gets its light for $82.40; Allegheney pays $72, and Wheeling is charged only $65. These cities own their own plants, and thus save money. He adds, it is argued that the municipal control of these plants gives the politicians a chance to do some of their crooked work. Well, do they have any the less chance for deviltry when they give out bids for the lighting of the city? It all becomes a matter of watching the tricksters. He believes the time will come when every city will own its light plants, just as now every city has its own system of parks.

WHO "NOSE" WHAT WE MAY COME TO.

A caricature published in Vienna, in 1832, shows the chagrin and vexation of the drivers and postillions of the "dilligence," when the passing train sounded the doom of their vocation. "It made them have big noses." If a similar result awaits the steam

BIG NOSES.

(A RESULT OF THE INTRODUCTION OF STEAM ON RAILROADS.)

railroad people in the approaching electrical railway, what a swelled nosed population there will be. The illustration is copied from La Nature, contributed by the managing editor of that journal, Gaston Fissandier.

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THE SCIENCE OF PHOTOMETRY.*

Discussion of Standards of Light Concluded—A Universal Standard Likely to be Secured—Photometers of Different Makes and Their Value.

BUNSEN PHOTOMETER PROBABLY THE BEST.

In 1891 the London Board of Trade appointed a committee "to inquire into and report to them upon the subject of the standards to be used for testing the illuminating power of coal gas." The report of the committee was made in May last. The committee found that the sperm candle is unsatisfactory, and a new standard is desirable; that the new standard should be equal to some multiple of the average standard candle light, and should be a flame; that the Harcourt pentane air gas is an exact standard, reliable and equal to one standard candle; that, a standard of greater candle power being desirable, the Dibdin pentane-argand is to be preferred, its reliability having been found satisfactory. The committee accordingly recommended that this standard be adopted as the legal standard, which will doubtless be done.

This standard is a No. 1 Argand gas burner, in which a mixture of air and pentane vapor is burned. The mixture is prepared by passing air through a Methven carburetter, containing pentane, to the burner. An opaque screen is mounted on the burner, so as to cut off the light from the top of the flame. The lower edge of the screen being placed 2.15 inches above the top of the steelite ring, through whose orifices the gas passes to the flame, the light emitted below the screen is said to be just equal to that of ten standard candles. The screen is used in order that the amount of light which passes it may be less affected by the height of the flame than in other forms of standard. If the reader will examine a gas flame, or a lamp flame, turned low, he will observe that the flame as a whole has different degrees of brightness, being dull at the outer edge, whitest in the center, darker again toward the burner, from which it finally seems separated by a blue portion, giving practically no light. On turning up the light it will be noticed that the several parts increase in size. If a screen be placed so as to cut off light from the outer edge only of the flame in its low position, and the flame be then turned up, more light will pass the screen, because the "body" of the flame, or area of white below the screen, is increased. If the screen be placed lower down at first, a little above the margin of the blue zone, and the flame be then turned up, the light emitted below the screen will be weakened. Between these two positions of the screen, a position may be found by trial, at which the screen may be placed, and allow the same quantity of light to pass though the flame height (in an Argand burner) be varied over an inch. With an increased height of flame the light-giving portion becomes brighter, but the exposed area becomes smaller, owing to the increase in the height of the blue zone, and the two effects balance when the screen is properly placed.

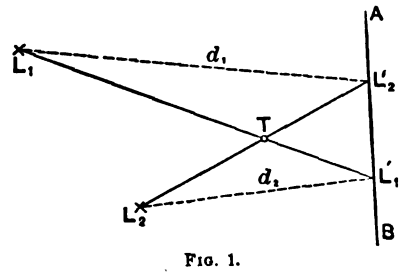

FIG. 1.
RUMFORD PHOTOMETER.

The proposed new standard is a decided improvement on the sperm candle. It is simple in construction and use. Its candle-power, ten candles, is convenient and brings photometer readings on to the more open parts of the scale, when used in measuring the candle-power of gas jets or incandescent lights. Its glass chimney is a weak point. If the thickness of the chimney be not exactly the same at all points through which light passes to the photometer, the glass acts as a lens, making the rays of light either more or less divergent than they would be if they did not pass through glass, and so making the effective position of the flame uncertain. A chimney gives rise also to errors on account of the light reflected by it.†

The whiteness and high candle-power of the flame of acetylene gas make it a desirable combustible. Now that carbide of calcium, from which the gas is prepared, has become an article of commerce, it seems likely that the difficulties attending its use may be overcome and a still better standard produced.

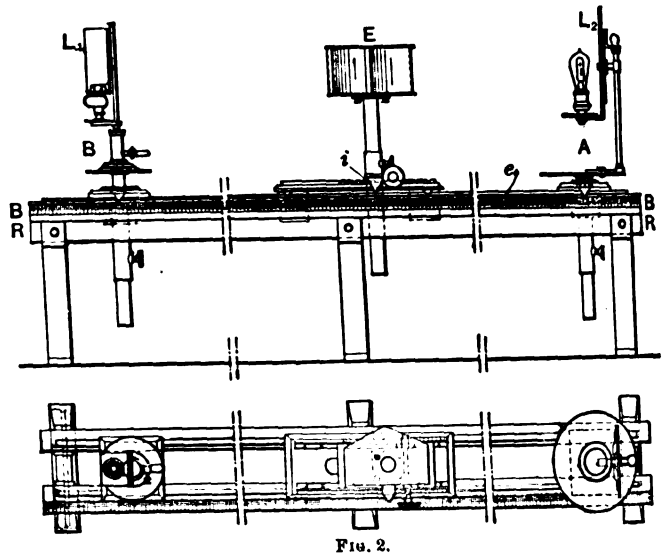

FIG. 2.
BUNSEN PHOTOMETER.

PHOTOMETERS.

Many methods have been devised for determining the intensity of light sources. The earliest methods were based on the observation of the number of sheets of neutral tinted glass, or translucent screens, or the thickness of a neutral tinted glass wedge required to make the light invisible. Other methods depended on the observation of the distance at which written or printed characters could be read by the eye. Other methods, some of recent date, combined those mentioned. It was soon found that these methods were unreliable, because they depended on the condition of the observer's eye at the time, which varied too much with his physical condition, and his surroundings, to admit of uniformity of results. All methods now in use avoid such trouble by making a comparison between the illuminations produced by a standard source of light and the light under test.

THE RUMFORD PHOTOMETER.

The first method which was found at all satisfactory was that embodied in the Rumford photometer. Its construction may be represented by figure 1. L_1 is the standard light, and L_2 the light to be tested. A B is a white screen, and T is an opaque rod, (e g a lead pencil), so placed that its shadows L_1^1 and L_2^1 fall side by side on the screen, but do not overlap. The shadow L_2^1 receives light only from L_1, while the shadow L_1^1 receives light only from L_2. If the distances of L_1 or L_2, or both be properly adjusted, the two shadows will appear equally lighted, and the illuminations produced at the screen by the two lights are equal. But we have seen that when this is true, the intensities of the lights are as the squares of their distances from the screen, calling I_1 the candle power of the standard L_1, and I_2 that of thelight L_2, $I_1 : I_2 :: d_1^2 : d_2^2$

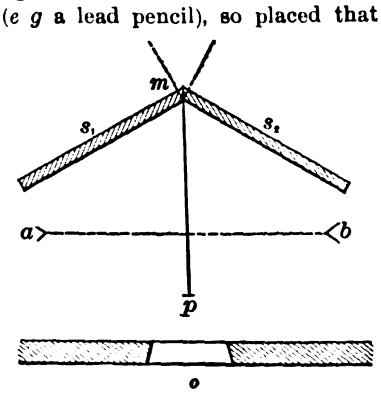

FIG. 3.
RUDOFF'S MIREOW.

$$\text{or} \quad I_2 = I_1 \times \frac{d_2^2}{d_1^2}$$

* Continued from October 1.

† See Proceedings of the International Electrical Congress, page 198.

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The method is very simple and may be easily tried, a sheet of white paper serving for the screen, a lead pencil, a foot rule or tape line, and any two lights to be compared being all that is necessary. It is understood of course that no light reaches the screen except that of the two lights under comparison.

With a little practice, fairly good results may be obtained with this method, if the lights be of the same color.

THE BUNSEN PHOTOMETER.

This photometer has been and probably is now more generally used than all others combined. Its distinguishing feature, invented by Professor Bunsen, about fifty years ago, is the use of a piece of white paper, having a grease spot on it, as the sensitive screen. If one hold a piece of paper, with a grease spot on it, between himself and a light, the spot will appear brighter than the paper around it, because the grease transmits light more readily than the paper. If looked at from the side on which the light shines, the spot will appear darker than the surrounding paper. If placed between two lights, so as to be equally illuminated by each, the spot will almost entirely disappear. Fig. 2 represents one form of Bunsen photometer.

B. B. is a track, consisting of one or two rails, on a table of convenient height, L_1 is the standard light and L_2 the light under test, the distance between them being constant. The greased paper, or "Bunsen disc," is placed at *E*, on a carriage which can be moved along the track between the lights. As the appearance of the disc varies with the angle at which it is viewed, and as it is desirable to see both sides at once, it is arranged between two unions as in Fig. 3; *p m* is the disc, both sides of which may be seen at *o* by reflection from the inclined mirrors s_1 and s_2. In use, the disc is moved back and forth between the lights until the two sides appear just alike. If the distance of the disc then be d_1 from the standard L_1 and d_2 from the light L_2, $L_2 = L_1 \frac{d_2^2}{d_1^2}$, as in the Rumford. The track *B B* usually has a scale engraved on it, giving the values of $\frac{d_2^2}{d_1^2}$ at proper points. If L_1 be of one candle power, the candle power of L_2 may be read directly from the position of the index L_1 (Fig. 2) on the scale. A Bunsen photometer of some form is used in most gas works.

If the lights under comparison be of the same color, the setting may be made quite accurately. If they be of different color, say a gas flame and an incandescent lamp, or a gas flame and a Welsbach burner, it is impossible to make the spot disappear, even approximately, and is somewhat difficult to make a satisfactory setting. In such cases better results may be obtained by using a 'Leeson" disc instead of the Bunsen. The Leeson disc is made by covering the two sides of a piece of thick white card board, in the center of which a hole with toothed edges has been cut, with very thin white tissue paper of even texture.

Benj. F. Thomas.

An interesting and puzzling freak of electricity manifests itself in the great four-and-a half mile Hoosac tunnel. It is found impossible to send a telegraphic message on a wire running from portal to portal of the tunnel, even though the wire be run inside of an ocean cable. As a result messages have to be sent on wires strung on poles over the top of the mountain, a distance of nine miles, and it is by this means that passenger and freight trains are heralded to the keepers of the two tunnel approaches. In the digging of the tunnel no ores, magnetic or otherwise, were discovered, but the impossibility of telegrahping is an existing fact.

Philadelphia may be a slow town, but they do some things pretty well down there. The city will this year receive in royalties, from street car lines, telegraph, telephone, gas and water companies, nearly $11,000,000.—*Aurora News.*

EXPANSION OF WELDED RAILS.

EDITOR ELECTRICAL JOURNAL.

Dear Sir:—Will you kindly inform me, through the columns of your valued paper, what provision is made in the joints of street railway rails for contraction and expansion of the rails, due to the variation in temperature of winter and summer, where the joints are made by pouring cast iron around the ends of the rails, whereby a practically solid joint is made, or where the joint is made by electric welding?

The Minneapolis Street Railroad Company are having a part of their track jointly made by the first named process, and as there is easily a variation of 100 degrees in the temperature of the rails here during the year, it seems to me that something must surely give way, as a variation of 100 degrees means a change in each 100 feet of track of nearly one inch in length, which would mean quite a bit in a mile of track. Hoping to be enlightened on this subject. Yours truly,

E. W. ASHENDEN,
3223 19th ave. S.

Minneapolis, Minn.

[The question raised by the above letter is a common one amongst people who see street railway rails joined by electrical welding or "cast welded" joints into coutinuous lengths. It would naturally be expected that continuous rails laid in hot weather would tear apart by contraction in cold weather, and those laid in cold weather would become very much bent in hot weather. This would be the case if the rails were laid on ties above ground, unless proper arrangements were made in some way to take care of the expansion and contraction. The condition is different, however, when the rails are embedded in the earth or in paving, as in that case at least two conditions are met, each of which greatly reduces the amount of expansion and contraction which would otherwise occur. In the first place, the embedded rails are not exposed to such a large variation of temperature as rails on the top of the ground. In the second place, the embedded rails are held so firmly in place by the earth or paving, that they are unable to respond to the tendency to expand or contract as the temperature changes. The latter condition seems to be the one which has the greatest effect in making solid joints in street car rails possible.—EDITOR.]

THE PROCESS "INVENTOR."

The Mining Industry and Review of Denver, as a preliminary to a first-class write-up of some electric apparatus, presents in pungent form a truth or two which has been made very evident to the careful observer. It says:

The electric age has given the process humbug a good chance to get in his work on the credulity of men, and make some ill-gotten profits for himself. There is something so fascinating in things we know nothing about; the poetic imagination, optimism and damfoolery which forms a considerable part of the make-up of most men, is worked on by mysterious influences and powers whose birth and life and death are accepted on faith only. This gives the world as good, legitimate, proper picking to fakirs, and they are always smooth fellows of brains who can be relied upon to pick, as they have been doing in this line for some half dozen years past. But all electric processes are not fakes, and all electric process men not fakirs.

The latest device of Alexander Graham Bell, like his telephone and other inventions, is in the line of practical utility. It is intended for the fishermen who are frequently cut off from their vessels by fog, and lose their lives as frequently by lack of drinking water as by exposure. The invention consists of a glass cylinder or bottle, through the neck of which is a small rubber tube. The glass is submerged, and a brass cylinder, acting as a bellows through the rise and fall of the waves, pumps the atmosphere into the submerged bottle. There it becomes condensed, and a supply of fresh drinking water is always to be obtained.—*Boston Herald.*

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ELECTRO-THERAPEUTIC DEPARTMENT.

TREATMENT OF RHEUMATISM.*

Effect of the Continuous Current in Arthritis Deformans or Rheumatoid Arthritis.

The following "*Notes on the Use of the Continuous Current in Arthritis Deformans, or Rheumatoid Arthritis,*" are presented with the twofold object of placing on record my experience in the treatment of this disease by electricity, and of obtaining in return the results of the experience of those fellows whose fortunate connection with the hospitals of large cities has given them the opportunity of studying the effects of the different modifications of electrical force upon this disease.

The disease is too well known to require any description, and the discussion of the etiology, whether of rheumatic or trophic nervous origin, has no place at this meeting. That Osler's statement, "No benefit can be expected from electricity," is a mistake will appear in the following report of a few of my cases.

Case 1.—Mrs. J. P., aet. 64, married, has had eight children. When thirteen years of age she had a very severe attack of acute inflammatory rheumatism, in which all the joints of both arms and legs were involved, and by which she was confined to her bed for eight weeks. At eighteen she had a second severe attack, involving all the joints. This attack was complicated by endocarditis, and left her with mitral insufficiency, which still remains. A persistent pain and stiffness of the joints of the hands and feet began shortly after her second attack of acute rheumatism, and grew worse steadily, but very slowly, till at the time of my first treatment in June, 1887, she was so bad she could not use either hands or feet; knees and elbows only slightly involved. All joints of hands and feet enlarged; fingers and toes badly distorted and very painful. I first tried the interrupted induced current supplied by a large Kidder coil. The applications were made daily, both locally and generally. At the end of one week I discontinued the faradic current, as no improvement was discernable, and the use of even the mildest current, supplied by my coil, caused her great pain. I then used the continuous current with large sponge electrodes. Seances, one-half hour, the first half of which I applied both electrodes to the affected joints; the balance of the sitting I applied the anode to the affected joints, and cathode to spine at base of neck. Strength of current governed by her endurance. Under this treatment the pain and stiffness rapidly subsided, and the nodes on the joints diminished perceptibly in size. Daily sittings were given for two weeks, then every other day for two weeks more, when she discontinued the treatment, as she had better use of hands and feet than she had had for many years. The improvement lasted about a year, when she got caught in a rain storm and got wet. From this time the old condition slowly returned. When she could no longer use hands or feet, she again had recourse to electricity. The continuous current was used, as above described on alternate days, and at end of fifth week she considered herself well and discontinued the treatment. The improvement lasted this time for nearly three years, when she went out into a hail storm to save a few pots of flowers, and immediately thereafter began to grow worse. Two years ago she came again for relief by electricity: This time I placed hands or feet, with anode, in a "foot tub" filled with warm water, and used 4x6 inch clay electrode as cathode over spine at base of neck. At the first sitting I found she could not bear more than twenty (20) m. a. on account of the burning of the skin at its contact with the surface of the water, and also under a gold ring she was wearing. After the sitting I found the skin very red at the point corresponding with the surface of the water, and, under the ring there was a blister. Thereafter I bandaged legs and arms before immersing them, so as to diffuse current at surface of the water, and had no further trouble, as with them bandaged she could easily bear from fifty-five (55) to sixty (60) milliamperes of current. Improvement was so rapid that she discontinued treatment at the end of the third week, and is still able to go about the house and even do some sewing.

Case 2.—Miss C., aet 54, had one attack of acute rheumatism when twenty-seven years old, both ankles and right wrist and elbow being affected. About twenty years ago first noticed the pain in the fingers of both hands. About a year later both feet became painful. The disease progressed steadily till all joints of both hands and feet, both wrists, elbows, ankles and knees were involved. Has been confined to bed or chair for past ten years. Hands and feet badly distorted. Muscles of arms and legs much atrophied. Had tried faradism several times with no improvement. I tried first faradic and then continuous current. For two weeks the daily use of faradic current, applied both generally and locally, produced no perceptible effect, except to increase the pain in her joints while the current was passing. A four weeks' trial of the continuous current lessened the pain in the joints and improved her sleep, but otherwise seemed to be without effect.

Case 3.—Mrs. F., aet. 48, married, has had seven children. She gives a history of one bad and two lighter attacks of acute rheumatism, affecting all the joints of arms and legs. No cardiac trouble. About fourteen years ago the joints of hands and feet began to be permanently sore. Phalangeal joints of both thumbs and both index and middle fingers badly distorted by the enlargement of the articular extremities of phalanges. The other fingers less distorted. Both wrists slightly stiffened, elbows and knees not affected. Both feet and ankles painful, but no distortion. I began with the faradic current, but she said I "was breaking every bone in her hands," and refused to go on with it. I then used the continuous current with sponge electrodes, one electrode to the affected joint, the other to spine at base of neck: I used 16 to 18 cells McIntosh battery. Sittings of half hour every other day for six weeks, at which time pain had left hands and feet. She could walk quite well and had good motion in metacarpo-phalangeal joints of hands, but the enlargement of articular extremities of phalanges and resultant crippling of the fingers was not affected.

Case 4.—Mrs. J. M., aet. 46, married, has four children. Has had numerous attacks of acute rheumatism, the first when twenty-seven years old, the last at forty-one. For the past twelve years has had constant pain and stiffness, both hands, wrists and elbows. Lower extremities not affected. Joints of fingers much enlarged and distorted. Can feed herself after the food has been cut up for her, but cannot dress herself. As legs are not implicated can go about as well as ever. The constant current was used with hands wrapped in clay for one electrode; the other, large clay electrode to the spine at base of neck. Current used was from twenty-five (25) to thirty (30) milliamperes. Sittings one-half hour each day for two weeks, after that every other day. After four weeks treatment the pain was almost entirely gone, and the joints (probably owing to freedom from pain) slightly more mobile. But here the improvement ceased, and as no further advance in mobility was perceptible the treatment was discontinued at the end of the eighth week.

Case 5.—Mrs. D. B., aet. 31, has had three children, the youngest five years old. Has had repeated attacks of acute rheumatism, the last about two years ago. Some thirteen years ago the joints of feet, ankles and knees became continuously painful and swollen so that she had to give up housework. But she assisted her husband with his tailoring. About nine years ago the hands, wrists and elbows were implicated, and all the joints began to enlarge. She continued to grow worse and muscles of arms and legs to atrophy. For past three years has been completely bed-ridden. Arms and legs not much more than skin and bone. Thighs less atrophied. Treated her daily, using faradic current a half hour, and then the continuous current for twenty minutes. Faradic applied generally and also locally to

*Paper by Dr. H. S. Jewett, of Dayton, Ohio, read before the Toronto Convention of the American Electro-Therapeutic Association, September 5, 1895.

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arms and legs; the galvanic, by means of soft clay, to hands and feet, and large electrode to spine at base of neck. She would be free from pain for about an hour after each application, but as no other effect was noticeable the treatment was abandoned after a months' trial.

Case 6.—Mrs. B. K., aet. 48, widow, had one child. Eleven years ago had one attack of acute rheumatism, affecting both feet, knees and left elbow. For past five years has had continuous "rheumatic" pains in both hands, wrists and elbows, also in both feet, knees and hips. Fingers slightly distorted and very stiff; wrists and elbows stiffened but not distorted. Knees and feet pain her most and are so stiff she can barely stand on them, and cannot walk at all without support. Muscles not atrophied. Continuous current used twenty minutes every other day, with bandaged feet or hands in water, with one electrode, the other to spine at base of neck, using forty milliaperes current. Six weeks' treatment gave marked relief from pain and decided reduction of the stiffness of the joints. She could walk slowly about the house witnout support, and even ascend and descend a few steps. Treatment suspended owing to her removal from the city.

Case 7.—Miss E. E., aet. 25, has had no acute rheumatism. Arthritis deformans began about eight years ago. All the joints of the body, except spine and jaw, are involved. Knees, ankles and all joints of both feet are immovable; hips very stiff. Very slight motion in fingers and wrists; elbows anchylosed, shoulder joints much stiffened. Large nodules on elbows and knees; all joints of hands and feet much enlarged; muscles of arms and legs badly atrophied. Has been absolutely helpless for past two years; sleeps very poorly; appetite very poor; has not menstruated for more than a year. She was anxious to try electricity, though I gave her no hope. Tried faradic current from long, fine wire coil, with singing rheotome, but had to stop immediately, owing to the pain it produced in the hands and wrists. Then used the continuous current. Applications were made every other day. Seances, half an hour. Began with fifteen m.a and gradually increased to 30 m.a. (all she would bear), using at first clay electrodes, and later immersing hands and feet in warm water. The latter method was much more agreeable to her. Treatment was continued for eight weeks, with no perceptible improvement of mobility. But the appetite improved, the bowels became more regular, there was marked diminution of pain, she slept better, and, finally, menstruation returned.

All the remaining cases on my note books are cases of pure Arthritis Deformans, with no history of acute rheumatism, like case 7, which was chosen as an extreme type of the disease. They differ from case 7 only in degree, or number of joints attacked, amount of pain, stiffness and distortion of joints and extent of atrophy of the muscles. In all those cases having no history of acute articular rheumatism, the only good I have been able to accomplish has been to give more or less relief to the pain, procure better rest, and an improvement of the general health. The atrophy and joint affection remained unimproved. I have not seen any evil effects result from the use of electricity. But, in those cases having a history of acute articular rheumatism, preceding the Arthritis Deformans, decided effects were attained by the use of the continuous current. The pain was always removed more or less completely, and with the removal of pain there was an increased mobility of joints. In one of my cases the enlargement around the joints was partly removed.

I am well aware of the fact that the number of cases seen by me is so small that no definite conclusions can be based upon them, and therefore hope the Fellows of this Association will report their experiences, stating the modification of electrical energy used and the results. As the disease is acknowledged to be incurable, everything that offers any amelioration should be promptly added to the very meagre armamentarium now in our hands.

My own experience has been confined to the use of the interrupted induced current, as supplied by a large Kidder coil, and, more lately, by a long fine wire coil with singing rheotome, and to the continuous current. In my earlier use, as I had no meter, I was obliged to control the current entirely by the sensations of the patients; now I practically do the same, though I know exactly how much current is passing.

My experience with the faradic current has been entirely unfavorable. The continuous current, on the other hand, has rendered good service, about 30 per cent of my cases being decidedly improved in every respect; another 30 per cent improved in general health appetite and sleep, though no better as to joint affection or muscular atrophy; while in the remaining 40 per cent the results were nil, or at least not appreciable either to patient or myself.

DIAGNOSIS IN GYNAECOLOGY.*

Conclusions of Dr. Apostoli in the Application of the Faradic and Constant Galvanic Current.

Dr. G. Apostoli, of Paris, after a long and thorough trial of the application of electro therapy as a means of diagnosis in gynaecology gives the following general conclusions:

1.—*The faradic current of tension* (generated by the coil of long and fine wire) applied to the uterine cavity, according to the rules established by Dr. Apostoli in 1883, relieves, for a longer or shorter time, all ovarian pain of nervous or hysterical origin; but remains powerless or nearly so in cases of ovarian pain caused by inflammatory lesion of the peri-uterine tissue or of the appendages.

2.—The same faradic current is therefore useful in diagnosis, inasmuch as it helps to distinguish the nature of so-called ovarian pain, and to determine rapidly the differential diagnosis between hysterical and inflammatory ovarian pain. Where the two kinds of pain exist in the same patient we are helped to understand their nature by the fact that the one is relieved and the other is not.

3.—If, then, the curative effect of the faradic current clears up or rectifies a doubtful diagnosis, it protects us at the same time, from undertaking a useless operation.

On the other hand, if the same faradic current proves ineffective, the lesion being inflammatory, we are led to resort to a supplementary galvanic treatment or to a surgical operation sooner or later.

4.—*The constant galvanic current*, applied to the uterine cavity in doses gradually increasing from 50 to 120 milliamperes, according to the rules published by Dr. Apostoli in 1884, and bearing in mind the individual susceptibility and tolerance, will be almost always supported without much pain during the séance, and without febrile reaction afterward, if the parts adjacent to the uterus are free from inflammation.

Simple cystic, peri-uterine tumors, which are neither inflamed nor suppurating (such as ovarian cysts and hydro-salpinx), may also show perfect tolerance of the galvanic current.

The galvanic current is also sometimes perfectly supported in cases in which the uterus is surrounded by old inflammatory products or exudations no longer pathogenic.

5.—There are three classes of cases which should be considered as exceptions to the preceding rule, for they bear the galvanic current more or less badly, though they do not necessarily produce much febrile reaction after the séance.

They are:—*A.*—Certain forms of hysteria.

B.—Fibro-cystic tumors of the uterus.

C.—Enteritis with false membrane.

It is generally easy to diagnose these cases of intolerance.

6.—All acute peri-uterine inflammation (of the pelvic cellular tissues, of the peritoneum and especially of the appendages) will cause the galvanic current to be badly borne when it passes 40 or 50 milliamperes, and will cause intolerable pain and febrile reaction when carried beyond this intensity.

7.—The intolerance for the galvanic current is generally proportionate to the extent and gravity of the lesions referred

*Paper read before the Toronto Convention of the American Electro-Therapeutic Association, September 5, 1895.

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to and increases with the intensity of the current employed—especially when it passes 40 or 50 milliamperes.

8.—All inflammation of the appendages which is *curable* (*symptomatically at least*) without radical operation, will bear the galvanic current better and better, and there will be a corresponding improvement of the prominent symptoms such as pain and hemorrhages.

The intolerance noted at the beginning progressively disappears.

9.—All grave inflammatory lesions of the appendages, and notably all suppurative processes which are *incurable* (*even symptomatically*) by conservative means, show the same intolerance from the beginning to the end of the treatment which was noticed at first, and which is apt to increase instead of diminish if the treatment is contined.

10.—Thus, the simple study of the tolerance or intolerance of the intra-uterine galvanic treatment, and especially of the post-operative pain and fever occurring on the evening of, or the day following the treatment, enables us to make the diagnosis. It also, in 4 or 5 séances, given twice weekly, informs us of the condition of the appendages, of their possible inflammation and its degree, and in this way it lessens the number of laparatomies and exploratory incisions.

11.—The same study of the so-called galvanic reactions also informs us rapidly (in 5 to 10 séances) of the curability of these inflammatory lesions which the electric current has demonstrated, and in consequence of this it tells us in one case to abstain from an operation while in another it shows an operation to be urgent.

12.—En résumé, Gynæcological Electro-Therapeutics, carefully, methodically and patiently applied, instead of being opposed to the marvellous progress of surgery, comes to its aid.

Independently, in fact, of the great therapeutic service which it renders every day, electricity serves as a *touch-stone*; it assists us in diagnosis and thus directly serves the interests of surgery, in one case showing an operation is useless and dangerous, in another that its necessity is urgent.

Thus many laparotomies, so-called exploratory incisions and mutilations practiced without due deliberation for the relief of rebellious ovarian pain or for lesions of the appendages of uncertain nature, should be, from this time forth, delayed or formally proscribed until all the resources of *faradic sedation* on the one hand and of the *intra-uterine galvanic effect* on the other, have been tried. Experience has abundantly proved these currents to be innocuous, if given with necessary aseptic precautions.

OPERATIONS ON THE NASAL SEPTUM.

Electrolysis by a Current Controller for the Reduction of Spurs of the Nasal Septum, is the title of an article by Dr. W. E. Casselberry, of Chicago, which appeared in the August 31 issue of the New York Medical Journal. Dr. Casselberry has adapted the Edison electric light circuit to this purpose by means of lamp resistance and McIntosh current controller. He has healed by this method ten cases, which he classes under three types: First, strictly cartilaginous spurs, of which five cases were treated; second, mixed cartilaginous and bony spurs, of which three cases are reported and third, bony spurs, of which two cases were treated. The author draws from the consideration of these cases the following conclusions:

1. As demonstrated by the cases reported under Type I, strictly cartilaginous spurs can be thoroughly removed by electrolysis—one, two, or at most three operative sittings being required. It is more tedious and less brilliant than the surgical method, but is not accompanied by any liability to immediate hæmorrhage and by only a remote possibility of secondary hæmorrhage. It is not to be indorsed as a universal substitute for the surgical method in even this limited class; but the number of individual cases, both in this type and in Type II, for which it is applicable is large, and with the efficiency, convenience and compactness of the McIntosh current controller, which adapts the Edison electric circuit to its use, together with properly constructed irido-platinum needles, I consider it a valuable addition to our resources.

2. As demonstrated by the cases reported under Type II, it will not thoroughly remove spurs which belong to that large class of mixed cartilaginous and bony substance; but it will reduce them in size, the amount of reduction being commensurate with the proportion of cartilage of which they are composed. The majority of such cases would therefore better be treated surgically, as being the more thorough method; but instances will arise in which the surgical method being declined, or being for some reason inexpedient, benefit may accrue from the use of electrolysis.

3. As demonstrated by the cases reported under Type III, spurs composed wholly or largely of hard bone cannot be successfully treated by electrolysis for the reason that needles can not be caused to penetrate properly, and further, it is doubtful if the process is adequate, even if the needles should penetrate, to the resolution of hard and dense bone.

4. Spur or excrescence, and not deviation of the sæptum, is the subject of this paper. Electrolysis is powerless to correct deviated sæpta of any form.

AN ELECTRIC MOUTH BATTERY.

A dentists' battery has been invented by Dr. L L. Funk of Chicago, and described in the Journal of the American Medical Association of August 3. The battery consists of a non-conducting plate arranged to fit in the mouth, metal plates of opposite electric polarity imbedded in the non-conducting plate, conductors connecting the metal plates, such conductors imbedded in the non-conducting plate, and such metal plates so disposed as to be exposed to the action of an electric excitation by the saliva or other fluids in the mouth, and the organs of the mouth to form elements completing the circuit of the battery. The object of the invention is to obtain an electric battery which can be worn in the mouth of a person for its therapeutic effect, and also to give strength to the plate when false teeth are worn. The inventor claims that it has relieved acute gastric disturbance, insomnia and closure of the eustachian tubes, with dullness of hearing and general catarrh of the nares.

PREMIUMS FOR SCIENTIFIC PAPERS.

The Institution of Civil Engineers of London, England, has issued an announcement of the subjects for which special prizes will be given to those who present the best papers or contributions. The Society has $2,000 annually which it distributes in promoting practical science, and the subjects have a wide range. This year there are ten topics out of a total number of sixty-six which deal in some form with electricity. They are:

1.—The most suitable steam power equipment for electric light stations.
2.—The utilization of electric lighting plant during hours of small demand.
3.—The utilization of electrical energy in the form of heat.
4.—The regulation of electric pressure in large lighting circuits as carried out at the engine, the dynamo, or the exciter.
5.—The theory and practice of the transmission of power by alternating currents.
6.—The use of electrical motors for driving machines in textile factories and in engineering shops.
7.—The first cost, faculty and economy of operation of electrical traction on railways with heavy trains and on tramways.
8.—The construction and working of electrical lifts and cranes.
9.—The electrolytic action of return currents in electric tramways on gas and water mains, and the best means of providing against electrical disturbances.
10.—The use of electrical machinery for lighting and the transmission of power in warships and in the mercantile marine.

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ELECTRIC PRESSURE.

Analogy Between the Dynamo and its Circuits and Pumps for the Circulation of Fluids.

It may be a help to some student if I draw once more the analogy between the dynamo and its circuits, and fluid pumps intended for the circulation of fluids.

Let *A* represent a centrifugal pump, and *B C D* a pipe leading from the outlet round to the inlet, so that the pump and pipe form a closed chamber, having no communication with the space outside. Suppose the dotted line at *C* to represent a valve by which the passage may be closed or opened. Suppose the whole filled with fluid. Now let the pump be put in motion, the valve at the top being closed. It is well known that the effect of the motion is to produce (generate) and maintain an increased pressure on one side and a diminished pressure on the other side of valve *C*, and that the amount of this pressure will depend upon the design and proportions of the pump, and the speed at which it is run. Open the valve, in consequence of the pressure, the fluid flows through, a current is set up throughout the pipe and pump.

Substitute for the pump the dynamo *D*, and for the pipe the conducting wires *E* and *G* attached to the brushes. To represent the closed valve *C*, leave a small break between the two conductors at *F*. The assumption is that the conductors throughout the entire circuit are filled with electricity, just as the pump and pipe are filled with fluid. Set the dynamo running and the effect is to move a small quantity of electricity through the dynamo from one side *G*, say, to the other, as it were, rarefying it on one side and compressing it on the other, and "generating" a difference of electric pressure between *E* and *G* in amount depending upon the design and proportions of the machine and the speed of rotation. Now let the conductors touch at *F*, equivalent to opening the valve in Fig. 1, electricity flows round and round the circuit, as shown by the arrows—an electric current is generated.

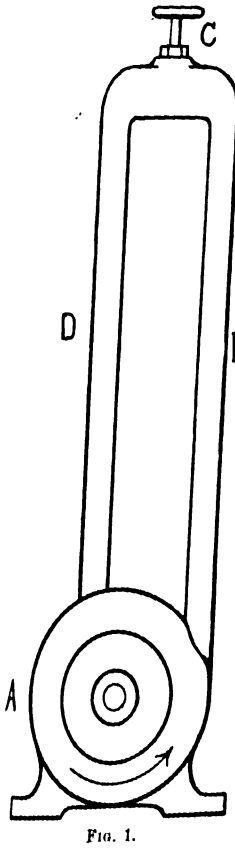

Fig. 1.

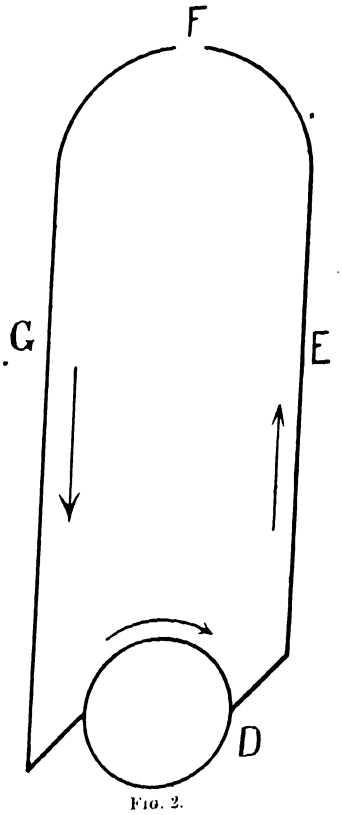

Fig. 2.

The difference of pressure between *B* and *D* of Fig. 1 may be demonstrated by means of any suitable pressure guage. The difference of electrical pressure between *E* and *G* may be demonstrated by the voltmeter or by the attraction and repulsion of light bodies. The flow of fluid in the circuit *A B C D* when the valve is open may be shown in various ways, especially by the warming of the pump and pipes. So the electric current in *D E F G*, when contact is made at *F*, may be demonstrated in several ways, especially by the warming of the dynamo and conductors.

A fluid motor might be introduced at *C*, to be driven by the energy of the moving fluid. An electric motor might be introduced at *F*, to be driven by the energy of the electric current.

Indeed, our electrical terms are all based upon the close analogy between the fluid-motion-generator and circuit of Fig. 1, and the electric-current-generator and circuit of Fig. 2.

Whatever theory of electrical phenomena we may adopt, or whatever theory the future may develop, it is certain that when the dynamo of Fig. 2 is in motion, a new condition exists in and around the conductors *E* and *G*, which we call difference of electric pressure or potential, and which, until we know more about it, we can best understand by considering it as the analogue of the fluid pressure in the pipes of Fig. 1. It is certain also that when the circuit *E F G* is closed, another new condition exists which we call an electric current, which, among other ways manifests itself by heating the conductors.

FRANKLIN L. POPE.

Mr. Franklin L. Pope, the well known electrician was killed at his home at Great Barrington, Mass., on Sunday night last, by an electric current.

Mr. Pope's home is lighted by electricity, and something had gone wrong with the lights. He went down stairs where the converter is located with lamp in hand to investigate the trouble, when an explosion and noise as of some one falling, were heard by the members of the family, who immediately rushed to the place to find that Mr. Pope had in some manner come in contact with the current and that he was already beyond human aid.

Mr. Pope was well and favorably known in the electrical world, being one of the pioneers in the work of bringing the mysterious agency under practical control. He was one of the first telegraph operators in the country. During the draft riots in New York in 1863, while in the engineer's office of the American Telegraph Company, he personally joined together the fragments of demolished telegraph lines between New York and Boston. In 1865 he explored British Columbia and Alaska in the interests of a route for the Collins Overland Telegraph, which was subsequently partially built and abandoned. Mr. Pope made many important inventions for the printing press and telegraph and electric block railroad signals. For several years he has been retained as expert in important patent suits brought before the United States Courts. He was a charter member of the American Institute of Electrical Engineers, and was elected its president in 1866, succeeding the late Dr. Norvin Green. Thomas A. Edison's first business venture in the electrical world was in partnership with Mr. Pope, under the title of Pope & Edison. Together they invented in 1870 the one wire printing telegraph that has now come into universal use, and is known as the stock "ticker."

Mr. Pope has written many scientific and practical papers on different phases of the electrical science, which have been read before conventions and published in the technical press. His sudden demise will be greatly regretted by a very large circle of friends.

The annual convention of the American Street Railway Association is an event which the Street Railway Journal commemorates from year to year by a special souvenir edition. The number just issued is an especially attractive one, and devotes a considerable amount of space to a description of Montreal, where the convention is held this year.

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

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Notice of Removal.

The publication office of THE ELECTRICAL JOURNAL has been removed to more commodious premises at 331-333 Dearborn street, Chicago. Correspondents will kindly note change of address.

* * *

The Storage Battery.

Mr. Barnett in the Journal, for October 1, accuses me of inaccurate statements as to storage battery traction. I wish to say only a few words in reply. First, the considerations to which I called attention in the Journal of September 1, referred only to the use of the battery on railways for traction purposes.

Mr. Barnett says, *if* it cost $100 per horse-power to install direct supply machinery, etc That is a very large "if".

When isolated plants in fifty horse-power units can be put in for $50 per horse-power, it would be a very surprising thing if central station plants should cost $100 per horse-power.

Where are the *users* of batteries who will say that the depre ciation of storage batteries is less than that of boilers, engines and dynamos?

The chloride cell *is* "a lead oxide battery, as that phrase is understood" by scientists and engineers of authority. Mr. Barnett's description of the mode of manufacture shows it to be so.

In order to reduce the generating machinery and run at a fairly uniform load, as Mr. Barnett describes, storage batteries, largely in excess of the maximum number of cars on the line, must be furnished, in order that there may be a stock of batteries to draw from during the busy hours. I repeat that this excess of storage batteries would cost more than the plant it would save.

Mr. Barnett compares the cost of underground construction with the cost of storage battery equipment at the rate of two cars per mile. I submit that no line using so few as two cars per mile would use an underground construction. Eight cars per mile, as a maximum for the busy hours, (and this determines the number of cars to be equipped,) is not large for a city line where underground construction would be required. Some lines in New York City run twenty cars per mile.

I have not taken into account "the smaller interest charge and smaller cost for power" because I have seen no reason to believe that any such saving is effected.

Wm. A. Anthony.

* * *

College Lectures.

Courses of lectures by prominent engineers upon matters of professional interest (commonly called non-resident lectures) are amongst the many good things introduced into engineering colleges within a few years, and which have done much to lend value to the courses of such colleges. The idea of these courses was probably borrowed directly from the professional colleges of law and medicine, but they have quickly become a necessity of every first-class engineering school. There are now at least half a dozen engineering colleges in the country, (and their number is fortunately increasing every year) whose students have the rare profit and pleasure of sitting at intervals before prominent engineers as they discourse upon some subject close to their heart. Such lectures are far reaching in their influence, and the information which they contain, however valuable it may be, is the least important of their features. The inspirations and enthusiasm born of such lectures is often remarkable, and it is a matter of congratulation to all electrical engineers interested in the welfare of the engineering schools that the names of Professor Elihu Thompson, Professor Alexander Graham Bell, Mr. Frank Sprague, Professor Elisha Gray, Professor Anthony, and many younger men of their stamp are to be found on college lecture lists. The college student who has the advantage of hearing lectures from the picked men of his profession, gains impressions which may be invaluable in his later professional life, and through non-resident lecture courses only can such advantages be surely obtained.

D. C. Jackson

* * *

Municipal Ownership.

The controversy in the daily papers anent the dismissal of Professor Bemis of the Department of Sociology, in the University of Chicago, takes on a wider meaning upon close scrutiny than would appear from a casual glance. It is hardly disputed that Professor Bemis was objectionable to the generous sponsors of the University, because of his advocacy of the control of large quasi public institutions by the public. In other words, Professor Bemis urged that the gas companies, telegraph and telephone, street railway companies and the like should belong to the public and be under government control, after the manner of municipal water works, and the government postal system.

The evidence that these doctrines were the cause of Professor Bemis' short stay in Chicago, is so conclusive that we may assume it is correct: then the question comes up—is Professor Bemis right, or are the gentlemen who are responsible for his undoing, right? Narrowed down to something we can see, the question is, are the institutions of this country the best, as against those of the more advanced European countries. The question affects the readers of this paper, because it contains within its principle, that other very live question of the municipal ownership of lighting stations.

The question may not be lightly settled. There are two very strong sides, and it will not do to compare America and Europe without making the comparison very carefully. In this country, the "rotation in office" tomfoolery will always stand in the way of the most efficient service in any government position until the classified civil service shall cover a wider field than it does at present. We know perfectly well, that while a big and able man is usually made postmaster general, he has very little to do with the office, and subordinates run the department—the

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head of the office usually contenting himself with the impression of his personality by some radical move in some particular direction, and because of his limited knowledge, the move is not always wise. Yet our postal service is perhaps the best public service that we have considering the money it costs, and we believe it is the cheapest service we have. The telegraph service of this country is certainly as good as the postal, yet it costs a good deal more money in proportion to the service rendered, and investment in its stock can be counted upon for a good return. In other words, the postal service is good and cheap. The telegraph service is good and costly. Every year there is a deficit in the postal budget, because the users do not pay all it costs, and the taxpayers generally, irrespective of whether they use the service or not, must make up the balance. On the other hand, those who actually use the telegraph pay all the service costs, and a good dividend to the stockholders, in addition. There is another thing however: if one loses a letter, there is no recourse, no matter how much of actual loss has been entailed; while if one is damaged by failure of the telegraph to do the business for which the company takes one's money, one may collect not only actual, but often speculative damages.

In England, where both the postal and telegraph systems are under government control, the postal rates are about the same as ours, and the service about as good; the telegraph rates are a little less than one-half as great as they are in this country. One may not recover for damage by postal loss, and only the actual money (sixpence or thereabout) is recoverable in case of damage by failure of the telegraph to perform service agreed upon.

The municipal ownership of water systems is hardly capable of comparison, as few large communities are dependent on private service, either in this country or Europe, but as a rule, municipal water departments are self supporting, by direct rate paying on the part of those who use the service. It is hardly fair to discuss, in this connection, ownership of lighting systems, because there can be no statement made that will not be questioned.

In Europe, where the governments control the steam railways, the service is not good. Whether it would be better if under private ownership, is highly questionable, as other service in the same countries is no better.

So we may fairly reduce the matter to two important footings: first, municipal or government ownership is desirable, if it is desirable to have the whole people pay the expenses of a service intended to benefit a part of the people; second, an exacting service, in which great damage is likely to arise, is better in the hands of a strong private corporation than under control of government, for the reason that government control always carries with it the principle that society cannot damage itself, hence the representatives of society—or government, cannot be held accountable in the shape of damage, while a private corporation can be made responsible. The former is utopian, and beautiful, but the latter is good practice, especially from the standpoint of an individual who is damaged.

* * *

Sunday Street Car Service.

In the city of Toronto street cars are not allowed to operate on Sunday. This is not the case, however, in some of the other cities of Ontario although there is a certain sentiment working in that direction, and the question will be authoritatively decided in the courts within a short time. An injunction has been applied for by one John Henderson, of Hamilton, against the Hamilton Street Railroad Company to restrain them from operating their cars on Sunday and the case will come before the Hamilton assizes in November. It is predicted that whatever the decision may be the case will be carried to a higher court. We suggest to Mr. Henderson and his ilk that they start an agitation for the adoption of the Connecticut Blue laws at once. Why stop with any half-way measures? Proper observance of the Sabbath is generally conceded to be a legitimate contention, but what constitutes a proper observance opens up a very wide question. There would seem to be ample scope for the enthusiasm of so-called reformers without conflicting with the reasonable exercise of personal liberty. Canada, like the United States, is of too cosmopolitan a character to admit of the successful operation of one law for the rich and another for the poor. The street railways are the carriages of the masses, and there is no more reason for depriving them of their means of transportation between given points than there is for depriving citizens of the use of private conveyances. If Mr. Henderson and those who are supporting him in his present action assume to dictate how the poor man shall ride on Sunday, they cannot, without laying themselves open to a charge of partiality, ignore the more favored ones who employ their own private conveyances. Unless Hamilton is very unlike any other city of any pretensions that we know of, Mr. Henderson will be able to find among the good people of that town those who have their coachmen drive them to church and call for them again when the service is over. Wherein is the difference between a case of that kind and that of the man of more limited means who avails himself of the street car service to attend church? Mr. Henderson will find, also, if he is not already aware of the fact, that the gentry who ride to church in their private rigs have servants at home who are deprived of the privilege of attending service, because it is their duty to prepare a hot dinner which their lord and master may enjoy upon his return from offering thanks for the many favors which have been vouchsafed to him and deploring the sinfulness of those who desecrate the day by manual labor.

If there is any good reason for suppressing street car service on Sunday, it is that the men necessarily employed in operating the lines may have an opportunity to enjoy a day of rest, and if Mr. Henderson undertakes to carry this principle to its logical conclusion, he will have his hands full for a long time to come. Street car service is a work of necessity in large cities and we mistake Canadian common sense if a submission is made to any such procedure as the one in question. There is such a thing as straining at a gnat and swallowing a camel, and it looks very much as though the Hamilton episode was a case in point.

* * *

Patent Office Methods.

In this issue we publish a paper from the pen of Mr. George D. Burton in defense of the Government Patent Office. Mr. Burton has done fully as much business with the patent office as any other inventor in the country, and no one is better able to shed light on patent office methods. Mr. Burton does not claim that the office is all that it should be, but he points out very clearly where the blame rests. We believe that the medical men regard diagnosis as the most difficult of their duties in combatting disease, and we believe the subject in hand to be a case in kind. To find out exactly where the trouble is, is one-half the work of its removal. Naturally the head of the patent office cannot unload the burden of the disgrace of his office on the shoulders of Congress or the Senate—else he would not be the head of the office very long, and it remains for the inventors and others having business there to talk out in the meeting and demand new methods, and, if necessary, new men.

We are very willing to agree with Mr. Burton that Congress is responsible for a good deal of the trouble, but we prefer not to shoot at a herd, and we think we would not miss the mark far if we were to point our gun at the Secretary of the Interior, and if our aim were to be disturbed and we should accidentally strike the wooden idol on the throne up behind Mr. Hoke Smith, we think we should still not have very much to apologize for. If the fish could just be persuaded to wait a little, while a small part of the country's business was being attended to, they would be entitled to the thanks of the business people.

* * *

Every Mickle Makes A Muckle.

It is a good principle in business that if the volume of trade is not large enough, a special effort should be made to augment it. This policy has been quite extensively pursued by the street railway companies recently in the form of special attractions at

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outside points with which their lines connect, and results have shown the wisdom of the plan. The public enjoy getting away for an hour or two from the hustle and bustle of city life. The ladies and children during the day are willing to pay railway fares to get away from the heat of a city and to some locality where they can enjoy a breath of fresh air. In like manner, those who are busily employed during the day, naturally look for a little diversion after hours, and if the street car companies afford it for the trifling expenditure of car fare, it will be freely indulged in. Many railway companies are prepared to strongly endorse the plan and there are few lines in connection with which it cannot be profitably employed. A case was recently cited of a line running out of Ottawa, Canada, where the receipts of a merry-go-round, which cost $2,500 to erect, had produced during the season a revenue of $5,000 in addition to the car fares which the patrons brought to the company. Street car companies are in the business for revenue and good management will suggest the adoption of any legitimate plan of drawing the nickles to their coffers.

* * *

Competition in Railway Traffic.

Elsewhere in this issue is a table giving the relative distances, fares, time and interval between trains on several steam and electric roads running out of New York. The table furnishes food for reflection, and will explain in a measure why electric lines are making inroads on the passenger traffic of steam roads. A reference to the table shows that the electric service has two distinct advantage over steam from the standpoint of the passenger. It costs less and trains are much more frequent. On the other hand it is shown that it takes nearly twice as long to reach a given point by the electric cars; but this drawback is minimized very greatly by the frequency of the trains. The chief disadvantage under which steam roads labor is apparently that the trains do not run often enough, and this cannot very well be overcome so long as steam is used. When people are ready to go anywhere they want to get started and prefer to spend a little extra time on the road if necessary, so long as they are on the move, rather than sit about and wait a half hour or an hour for a train to start. The management of steam roads are not blind to the situation, however. On the contrary, they recognize that the electric street car service for short distances is an agressive competitor for the business they have so long enjoyed a monopoly of, and the general adoption of electricity on short lines which has already been started will be extended rapidly.

* * *

Loose Fire Underwriters Methods.

There seems to be something radically wrong with the methods of the New York Board of Fire Underwriters if judgment may be based on the complaint of a correspondent of the Insurance Advocate. It is charged that the inspection certificates issued by the Board are worthless; that after an electric lighting plant has been installed and certified to as being all right, it turns out that other insurance interests decline to accept the Board's certificates and in certain instances have demanded that a new installation be made. When complaint is made it is *first* met by the Board by a suggestion that no attention be paid to the demands of the other insurance interests, but a little later on, an order is issued that the plant *must* be rearranged. Such action would seem to be neither rational nor reasonable and there is an evident urgency for some remedial measure. A plant is either properly installed or it is not, and the inspectors of the New York Board of Fire Underwriters should know which, and be prepared to stand by its certificates when issued. There is great need of harmony of action among the fire underwriters, but we suppose if they get together, the public would be no better off, as the fleecing stage of the game would be in season.

* * *

What a wonderful beneficence is optimism. The grand boom is on, prices are going away up, and we are all to be rich. And yet—?

British Inventive Genius.

The British scientists, for want of better work, have set themselves the task of proving that they are not behind this country in everything electrical. The Britisher is nothing if not ambitious, and he has soared very high when he assumes so herculean a theme for his intellect. He starts out with the claim that Morse did not invent the telegraph. The rest of his contentions are not less interesting and quite as funny. He then takes issue with us on the present status of the telegraph business in the two countries. Mr. Preece, as the Sir Oracle of the genus "Practician," also claims that the telephone in his country is far ahead of what we are pleased to think is a good service over here. Up to going to press the British have not claimed the invention of the telephone, but there is yet time. In other electrical lines our good cousins are also far ahead of us, but we are disposed to contend with them for priority and superiority, save and except in the matter of pure, undefiled, rock-ribbed and iron-clad nerve. There we admit our utter weakness. After the late war, the men who talked the most about their unquenchable blood-thirstiness in battle, were those who robbed hen roosts and frightened women and children. So it is with our stolid Cousin John It is still "nine men in buckram."

* * *

The Electrical World is warming up to its work in the series of articles on the Electro Magnetic Telegraph. Those who have given ready ear to the fiction of Alfred Vail's "claims," need only to read a few of the letters between Morse and Vail, published in the October 12th number, to be undeceived. If Mr. Vail's friends were wise, they would drop the matter. On an occasion Napoleon said to his Secretary, Bourienne, whose head had grown apace with his high office, "if you are remembered at all fifty years hence, it will only be because you were near me." And so it came to pass.

The Electrical Standards Committee of the British Association has as at last greatly relieved the strain we have been under by announcing that "the new units and nomenclature were brought forward as tentative recommendations or suggestions, which, it was hoped, might meet with the approval of electricians at home and abroad, rather than as hard and fast laws, which should admit of no re-discussion." Now that we are allowed to discuss the subject, we shall feel much better.

A report from the Atlanta Exposition says that of all the buildings on the grounds, the exhibits in the electricity building are the worst delayed. This is not very complimentary to electrical interests, and it behooves the exhibitors in that department to redeem their reputation. The blame, however, does not attach alone to the exhibitors. If the exposition buildings had been completed earlier, and if the work devolving upon the management had been farther advanced, the exhibitors would not have been so much behind.

The German Hygienic Association has offered a prize of $1,200 for the best essay on electric heating. Here is a chance for our friends of the British Association who have been firing a lot of blank cartridges in the way of words. It is true, we of this country have done most of the practical work in the field of electric heating, but that fact should not prevent our English friends from telling the story—especially with $1,200 in the perspective.

The great drainage canal which Chicago is providing for her sewage, promises to be even a greater boon than was originally designed. There is a probability now that it may furnish also an abundance of water power for the generation of electric current, which may be utilized advantageously in and about Chicago. Evidently Chicago built better than she knew, but "everything works together for good to those who love the Lord."

The life prisoner in the Ohio State Penitentiary who, having invented a telephone transmitter was paroled, may wish himself again under the protecting influence of the State when he gets tangled up in the telephone warfare, which is at present waxing warm throughout the country.

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A report is current that a bill will be introduced in the next meeting of the legislature of Ohio providing for the infliction of the death penalty by electrocution instead of hanging. We greatly mistake public opinion if this method of capital punishment extends beyond the limits of the State of New York in view of the experience that has been had with it there.

The German Kaiser has a telephone car follow him on his hunts and travels. We assume that his majesty goes hunting and traveling in order to forget for a time that he is a King. We think we could promise him entire forgetfulness of the fact if he would employ a few of our hello girls to do business at the exchange end of the phone for a while.

The "new woman" was found booted and spurred and pantalooned, at the top of a telegraph pole in Bridgeport, Conn., the other day, doing a man's duties—that is she was found there by a live wire. When she reached the hospital, her sex was discovered—she probably called for a mirror to see if she was disfigured, and thus gave herself away.

If the members of the American Street Railway Association are received in Montreal with that same hospitality which made so pleasant the meeting of the National Electric Light Association there in 1891, it is reasonable to assume that the annexation sentiment in this country will receive an early and substantial impetus.

A few of us will be able to stir the bitter waters of remembrance and find a sediment of sympathy for the managers of the Electrical Department of the Atlanta Exposition, who are receiving the maledictions of mankind just now. But why trouble ourselves with other people's troubles? Down with the tyrants!

The proposition to utilize the Chicago drainage canal to generate electric power has taken on an added interest by the announcement that the question will come before the new board of trustees as soon as it is elected. It is contended that a sufficient amount of power can be made available to warrant a large outlay.

Out of the fullness of our experience at the Montreal meeting of the National Electric Light Association, of 1891, we beg to guardedly but impressively warn the delegates to the Street Railway Convention that Montreal has a rarefied atmosphere, and one's head swims easily. A word to the wise——.

An electric street car was "held up" in Evanston, Ill., by four masked men a few days ago, and the passengers were powerless to offer successful resistance. This suggests an opening for some genius to utilize the deadly trolley as a means of "defense," as well as "offence."

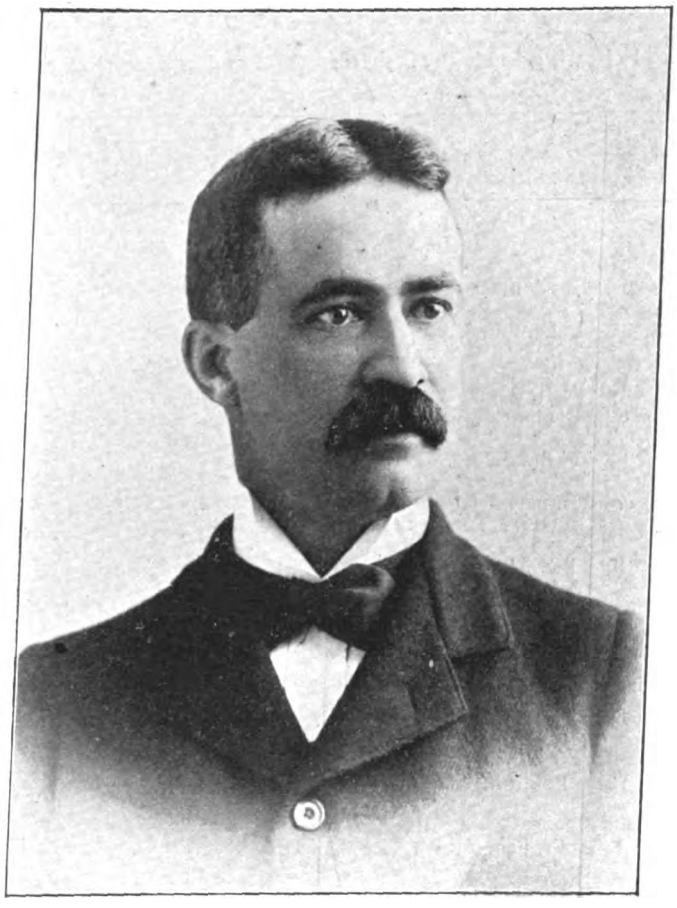
Things are travelling very smoothly for our friend George D. Burton these days, and we may safely expect large chunks of silence from him on the killing capacity of the electrical current. Some people die by the current, but others live by it. Yes they do, George!

There seems to be a suspicion that the Niagara Falls Power Company is more of a land grab than a water power, and that its promoters would rather sell land at the Falls than electricity at a distance. In the meantime the Buffalo City Council is the "fetch and carry."

Is it not about time the daily papers were blaming the "deadly trolley" for the highway robbery and shooting affray that occurred on the Chicago-Evanston Electric line a few nights ago? Our friends of the lay press seem to be missing some fine chances.

Prof. George Forbes still stands on the banks of the Thames making up faces and "calling names" with his eyes toward the West. Yet we are not wholly unhappy. Prof. Forbes is on the Thames.

A Bridgeport, (Conn.) woman climbed a telegraph pole to fix a wire, and touched an electric light wire. She was worse shocked than those who saw her climb.—*Cleveland World.*



WILLIAM EDGAR BAKER.

Mr. Baker was born at Springfield, Mass., in 1857, and to-day at the age of 38 is the moving spirit in one of Chicago's greatest enterprises. Mr. Baker's ancestry dates back in this country to 1730, when Henry Baker came from England and settled near Rahway, N. J., where the old homestead still stands.

The subject of our sketch obtained his early education in the common schools, and later at Lafayette College, Easton, Pa., where he graduated in 1877. Later he joined the engineering staff of the St. Paul, Pacific and Canadian Pacific Railway, and finally became Chief Engineer of the International and Great Northern Railway, which position he retained until 1889. His first electrical work of any special account was the installation of the first electrical equipment of the West End Street Railway Company, of Boston. During the preparation and continuance of the Columbian Exposition, he had charge of the construction and operation of the Intramural Railway, which was the first application of the third-rail system, and which has since been applied to the operation of the Metropolitan Elevated Railroad in Chicago. Mr. Baker is at present General Superintendent of the Metropolitan Elevated, and under his direction it is rapidly becoming one of the great transportation systems in the country.

Mr. Baker has that urbanity and persuasiveness necessary to take him into any company, business or social, and get him out again without a feather being ruffled. He is a married man, having a very lovely wife and four equally lovely children.

James and John Treadwell the Alaska miners have incorporated a company with a capital stock of $3,000,000, for the purpose of generating the electric current from refuse coal at Correl Hollow mines. This current they expect to utilize in the surrounding country within a radius of seventy-five miles. It is a large undertaking and will probably not be in operation short of eighteen months or two years. The first points to be supplied will be San Jose and Oakland, and ultimately it is hoped to carry the current to San Francisco.

A runaway team in Baltimore ran into a telegraph pole, breaking it off near the ground and scattering the wires in all directions about the street. These wires coming in contact with the heavily charged trolley, became charged themselves and conveyed the current to the iron gutter plates at the intersection of two thoroughfares. A horse passing at the time, stepping upon the plate, received a heavy shock and fell to the ground. A prompt cutting of the wires saved the life of the animal, though he was badly burned, and bled from the nose and mouth.

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EUROPEAN TELEPHONE SERVICE.

The Following Table, Taken from the London Electrical Engineer, Provides Some Interesting Facts Regarding European Telephone Service.

Order of Merit.	County.	Population.	Number of Exchange Telephones.	Number of Persons to Each Exchange Telephone.	Characteristics of Management.
	GROUP I.				
1	Norway	2,000,917	13,943	144	Very low rates. Local management of exchanges. Good rural intercourse. No competition.
2	Sweden	4,784,981	32,602	147	Very low rates. Local management of exchanges in part. Good rural intercourse. Competition.
3	Luxemburg	211,088	1,315	160	Very low rates. Central management, but with delegated control in some cases to local authorities. Good rural intercourse. No competition.
4	Switzerland	3,000,000	17,422	172	Ditto. ditto. ditto.
5	Denmark	2,185,335	10,325	211	Very low rates. Local management of exchanges. Good rural intercourse. No competition.
6	Finland	2,412,135	7,351	328	Very low rates. Local management of exchanges. Good rural intercourse. Competition.
	GROUP II.				
7	Imperial German Post Office Territory	41,796,966	93,131	449	Fair rates for urban subscribers in large towns; high rates in small towns. Highly centralized management. Bad rural intercourse. No competition.
8	Bavaria	5,594,982	12 400	451	Ditto. ditto. ditto.
9	Wurtemberg	2,036,522	4,430	459	Low rates for urban subscribers, but with regulations tending to restrict suburban and rural intercourse. Centralized management. No competition.
10	United Kingdom	37,880,764	59,569*	636	High rates, with regulations unfavorable to development outside towns. Local management in part. Practically no competition.
11	Holland	4,669,576	7,263	643	High rates in three chief towns; low rates elsewhere. Management chiefly centralized. Bad rural intercourse. No competition.
12	Belgium	6,136,414	8,757	700	High rates in large towns; low rates of recent origin in small towns. Centralized management. Indifferent rural intercourse. No competition.
	GROUP III.				
13	France	38,343,192	26,772	1,432	High rates; subscribers also pay capital cost of their installation, except in Paris and Lyons. Centralized management. Bad rural intercourse. No competition.
14	Spain	17,800,000	10,984	1,618	High rates in large towns. Recently introduced reduced tariff for smaller towns. Local management. Bad rural intercourse. No competition.
15	Austria	23,895,413	14,574	1,640	Fair rates, but subscribers pay capital cost of their installations. Centralized management. Bad rural intercourse. No competition.
16	Italy	30,535,848	12,067	2,530	High rates in large towns, except in Rome, where competition exists; low rates in Rome and in small towns, but under strict government supervision. Bad rural intercourse. No competition except in Rome.
17	Hungary	17,463,473	5,563	3,139	High rates in towns; very low rates in villages, but combined with regulations which tend to restrict communication between towns, suburbs and villages. Partly local management. No competition.
18	Portugal	5,000,000	1,483	3,371	Exchanges only in Lisbon and Oporto. Fair rates. No rural intercourse. No competition.
19	Russia	97,151,789	7,415	13,102	Highest rates in Europe in chief towns; high rates in smaller towns. Partly local management under Government rules. Bad rural intercourse. No competition.

*Company, 58 367; Post Office, 1,202.

CONTRIBUTED BY THE BUSINESS OFFICE.

Some cooks bake with cottolene,
" " " " lard,
" " use no grease at all,
But their crust is mighty hard.

Some men chew their plug tobacco,
" " " the tag,
" " never work their jaw
Except to chew the rag.

Some men put their ads. in papers,
" " " them on the fence,
" " never advertise,
Who ought to have more sense.

—*Mankato Review.*

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

GROWTH OF THE ALUMINUM INDUSTRY.

The table below shows at a glance the progress of this industry, which is of interest to the electrical world.

Years.	Weight in Kilogrammes.	Value in Francs.	Price per Kilogramme in Francs.
1884	68	6 952	102.6
1885	128	13 132	102.6
1886	1 360	139 050	102.6
1887	8 154	303 850	37.3
1888	8 607	334 750	39.0
1889	22 215	101 875	23.2
1890	27 760	315 597	17.6
1891	67 950	515 000	7.5
1892	117 269	880 095	7.5
1893	153 932	1 374 550	8.5

Owing to defective brakes an electric car ran down a hill in Pittsburg, October 13, killing four people.

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ELECTRICITY IN JAPAN.

Many Railways Projected—Germans and Belgians Pushing Trade There More Than Americans.

Wm. E. Curtis, who has been on the ground, and knows whereof he speaks, says that "Numerous companies have been organized for the construction of electric railways in Japan, and many of them will doubtless carry out their plans in the immediate future. One proposes a trolley line in Yokohama, another an extensive system in Osaka, the most enterprising city in the empire, and the second in population. Another contemplates the extension of the present trolley line in Kyoto, which is the only one in Japan. Similar enterprises are on foot in Nagoya, Kobe, Fagasaki and other places, and it is certain that within the next few years all the cities will be amply provided with street-railway facilities, although there are now but two lines in the whole empire—those in Tokio and Kyoto, to which I have referred.

"There are also applications pending before the government for electric lines between Yokohama and Tokio, a distance of eighteen miles, and between Kobe, Osaka and Kyoto, forty-eight miles, where the territory is very thickly settled; but both of them propose to parallel steam railways owned by the government, and it is a question whether they will be permitted, for financial reasons. The present roads pay dividends of 9 per cent and more into the public treasury, and their earnings would be reduced by competition.

"Although Americans and other foreigners may not actively engage in the management of these enterprises, they offer a very tempting opportunity for the investment of capital, and will afford a large market for steel rails of light weight and electrical material when their construction is commenced.

"The Japanese are very well advanced in the science of electricity. A large number of native engineers and electricians have studied in Europe and the United States, and there are manufactories of electrical supplies in most of the larger cities, which turn out much of the ordinary material now demanded, although they have not yet attempted to produce motors. Some of the finest electric plants in the world are found in Japan. They are used for coal-mining, cotton-spinning, lighting and for general manufacturing power, and at Kyoto boats are carried up and down the rapids of a river just outside the city by apparatus that is said to be as complete and ingenious as any in existence. It was planned and constructed by a young native engineer, but the machinery was purchased in Germany. The same plant lights the city, runs a street railway and several small factories. It now furnishes 28,000 horse-power, which may be increased indefinitely, as the water-power comes through a canal, also used for irrigation and navigation, and from Lake Biwa, which is forty-seven miles long, an average of nine miles wide, an average of ninety feet deep, and receiyes the drainage from a large range of mountains.

"Telephone lighting and ordinary mechanical apparatus and supplies are produced in Japan. They are mostly imitations of European and American patents. The materials and some of the parts for motors and other machinery are imported from Germany and Belgium, but they are put together and the simpler parts are supplied here. It will always be necessary to import materials, as they do not exist in Japan, and foreign appliances are so much superior to the local products that wiser people prefer them even at a much higher cost, and will continue to do so until the Japanese have reached a similar state of perfection.

"There are several large houses dealing in foreign electrical supplies, and one finds contributions from Brush, Edison, Thomson-Houston, Westinghouse and other American manufactories; but the Germans and Belgians have pushed the trade with greater energy than our people, and consequently have sold more goods. They have established agencies under competent engineers, who learn the Japanese language and mingle among probable purchasers, to make their acquaintance and talk business. The Europeans do not appear to be afraid of the infringement of their patents.

"American manufacturers must take the same measures if they wish to increase their sales. They can do very little by correspondence or by sending catalogues. They must go to Japan themselves, get acquainted with the people, study the peculiar requirements of the market and the methods of doing business, and conform to them as closely as possible. Long credits are not expected as a usual thing, but the purchaser will usually insist on paying on deilvery through the Japanese banks.

"I cannot discover that European merchants ever lose money by accepting contracts or filling orders if they comply strictly with their provisions, but the Japanese are a suspicious people. They have been taught by an expensive experience to distrust foreigners. When the country was first opened to trade they were humbugged and swindled right and left, particularly by Englishmen, and, I regret to say, by some Americans. This not only made them cautious in their dealings, but they learned a great many tricks which they often practice now upon their former instructors. When they have once learned that they can place confidence in a man they trust him implicitly, but when there is a contest of wit the Japanese is a hard man to beat. As a trader he will rank with the Jews, Greeks and Armenians. A dishonest Japanese is utterly unscrupulous and audacious to an amazing degree. But among the people generally you find as high an average of honorable men as in any European country or the United States, and when they recognize honorable dealing they return it in kind.

"The government is a very large buyer of telegraph, railway and electric supplies. It patronizes home industries wherever practicable, but the policy is to get the best possible material for the money, and the officials recognize the inferiority of the Japanese products. Some of the electric light plants are owned by municipal corporations, and they buy a great deal abroad. The railway iron used both by the government and private corporations for steam and street railways is much lighter than we are accustomed to in the United States. Most of it comes from Belgium and England, but it might be shipped by sail from the Atlantic coast ports of the United States and placed in Japan at prices quite as cheap as those charged for European goods."

ELECTRIC AND STEAM RAILROAD COMPETITION.

Some idea may be obtained of the nature of the competition between the steam and electric railroads in the vicinity of New York from the following table, in which the distance, fare, time consumed in the journeys, and interval between trains are given. The fares, it will be seen, are about 25 per cent less, but the time consumed in the journeys is nearly doubled. But, on the other hand, the intervals between trains on the electric roads are only one-sixth to one-twelfth as long. Obviously such competition is a serious matter to the steam roads.

From New York to	Distance.	Fare Round Trip.		Time.		Interval Between Trains.	
		Electric.	Steam.	Electric.	Steam.	Electric.	Steam.
	Miles.	Cts.	Cts.	Min.	Min.	Min.	Min.
Greenville.....	4 2	15	20	40	18	5	30
Bayonne.....	7.7	15	25	60	27	5	30
Newark.....	9	20	25	50	30	5	30
Orange.....	12	30	50	80	45	5	30
Elizabeth	12.5	35	50	80	40	5	60
Bloomfield.....	13	30	45	80	50	5	60

—*American Engineer and Railroad Journal.*

Mayor Pingree, of Detroit, has consented to serve a fourth term if it should be the wish of the people. It is claimed that the four corner stones of his popularity are his potato patch scheme, the securing for the city a splendid electric lighting plant, in having gas reduced to 80 cents, and in securing a three cent fare from the electric street railways.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students. Personal and Pertinent.

REVISION OF GENERAL COURSE.

It seems necessary and desirable to say something concerning the revision of the lessons of the general course, which has been in progress by members of the faculty of the school for some time past. There has been a feeling for some months on the part of some members of classes and most instructors that the length of time required for completion of the work was too great, it being forty-five weeks, or rather forty-five lessons, and as most classes meet only once each week, and as there are at least a few holidays in the year, and almost invariably classes find it necessary to adjourn over at least a few other class nights, the course runs over the year before it is completed. Moreover classes desire a review of at least the more difficult lessons, and again the time of the course is lengthened.

All these reasons have prompted a revision of the general course and a contraction of it to thirty-five lessons, instead of forty-five as heretofore. In assuming the task of this revision, Professor Jackson, who has borne the burden of the work, determined to strengthen some of the lessons by the addition of matter that has come to hand, or been suggested by the developments of the past eighteen months. No matter has been cut out, and the more difficult lessons have not been increased either in length or matter. It is thought that the changes made in this revision and re-arrangement, and a very material increase in the quantity and improvement in quality of apparatus used, will make a much stronger course throughout.

Those who have applied for and have not yet received the bound volumes of lesson leaves, may find the reason in this revision. They may be assured they will receive the copies as soon as they are ready, which will be only a very short time now.

THE SCHOLARSHIP EXAMINATIONS.

The scholarship examination for the Chicago district of the school has been concluded and the papers marked. There were eight candidates, all of whom had received a per centage of 90 or over in the first examination. Names and per centages follow:

A. H. Gehle, Chicago.....per centage, 97
A. Fontayne, Chicago.....per centage, 97
C. Cassord, Chicago.....per centage, 94
A. C. Pitkin, Chicago.....per centage, 93
J. W. Luce, Oak Park.....per centage, 92
F. Dickinson, Chicago.....per centage, 85
F. M. Pebbles, Oak Park.....percentage, 85
Archie F. Wheeler, Chicago.....per centage, 79

It will be seen that Messrs. Gehle and Fontayne have won the scholarships, which are complete courses in the laboratory just equipped for the school, of which our next number will contain a complete description.

Both the gentlemen are to be congratulated on their victory, as the examination was very hard, and they won over some very well informed men. All the other six students may also feel much pride in the results of their efforts. Both examinations were calculated to test very thoroughly the practical knowledge of students, and a per centage of 90 in the first, and the above high averages in the second are significant of the work that the men have done.

Most of these eight men will be students of the laboratory, and all of them are determined to fit themselves for expert positions.

Professor F. A. C. Perrine, of Stanford University, Palo Alto, California, and a member of the faculty of The National School of Electricity, has been appointed local secretary for San Francisco of the American Institute of Electrical Engineers.

A PRESENT TO THE LABORATORY.

Mr. George D. Burton has presented to the newly-equipped laboratory of the National School of Electricity a complete electrical forge and welding outfit of his invention. The gift is the more highly valued, because of the fact that the Burton electric heating devices are coming into common use, and an opportunity to teach their principles to the coming generation of electricians is a necessity for every well-ordered laboratory, since it is the aim to teach those things that students will be called upon to use in every day work. The school management begs to acknowledge Mr. Burton's generosity and to express appreciation of it.

Mr. Louis T. Kaiser, a member of the Cincinnati class of The National School of Electricity, has just completed the erection of an electric light plant for the works of the Emery Candle Company, at Ivorydale, O. At the trial test everything went off smoothly and satisfactorily. Mr. Kaiser is to be congratulated on this successful entry into the professional field.

Michael T. O'Dea, professor of electrical engineering in the University of Notre Dame, Ind., and who also is a member of Faculty of the National School of Electricity, has been obliged, owing to ill health, to take an extended vacation. He is at present enjoying the balmy atmosphere of the Pacific slope.

PULLED 3,800,000 POUNDS.

The Wonderful Power of the Belt Line Railroad's Big Electrical Engine Demonstrated.

The largest burden ever drawn by a traction engine was pulled through the Belt Line tunnel yesterday morning with comparative ease by Electrical Locomotive No. 1, of the Baltimore and Ohio Railroad, says the Baltimore Herald of the 7th inst.

The load weighed 1,900 tons approximately, and consisted of 44 loaded cars and three steam locomotives not at work. The trains pulled through were the regular northbound freight and the Canton local. The burden numbers just seven cars more than have ever been taken through before, and the ease with which the electric engine drew the long line of cars is considered wonderful.

The engineers and electricians in charge of the big trolley motor have been gaining in confidence in the ability of their new drawing power to do the work, but yesterday morning all their doubts were dispelled, and they now think that nothing is beyond the power of electricity. What made the pull more surprising was that both the freight and the local were sidetracked on a fairly steep grade, and it was necessary to start them up hill in order to get them along.

It is estimated that a dead pull of 60,000 pounds was necessary to start the train, and a pull of 40,000 was needed to keep it in motion. When the electric engine made the great haul there was seemingly no difficulty, and an easy speed of 12 miles an hour was maintained all through the tunnel. One steam engine could not have pulled half of the load which was taken along so easily by electricity.

The regular steam locomotive has as its limit the drawing of 1,000 tons, or 28 cars and two dead engines, and it would have been necessary yesterday for at least four engines to have been provided to do the work of the electric car.

Electric Locomotive No. 1 has been in active service continuously since August 4 last, and has never failed to come up to the most sanguine expectations as far as drawing power is concerned. The second locomotive is in course of construction, and will be ready in three weeks.

Send in your subscription to THE ELECTRICAL JOURNAL.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

According to Figaro, M. Lebon, the French Minister of Posts and Telegraphs, has signed a contract for laying a cable between Brest and New York.

A telegram from St. Petersburg states that a telegraph line is to be established between Bachta and Tchugutscheek in Siberia, which will primarily facilitate telegraphic communication with Western China.

The telegraph business of the United Kingdom, which is under state control, shows a deficit for the past year of £452,803. The number of messages transmitted numbered 71,000,000. In 1870-71, the first year after the transfer of the telegraphs to the state, the number of messages was only 9,850,000.

Charles F. Kline, known as the prison inventor, who has patented a telephone transmitter, was paroled from the Ohio penitentiary, October 1. Kline was convicted three times for burglary in Montgomery County, and sentenced for life under the habitual criminal act. He is the first life man to be paroled.

One of the curiosities of the cable code method of sending information is shown in a recent message announcing the loss by fire of a ship at sea. The whole message was conveyed in three words of Scott's Cable Code: "Smothered, hurrah! hallelujah!" "Smothered" stands for "the ship has been destroyed by fire;" "hurrah" for "the crew saved by boats," and "hallelujah" for "all hands saved—inform wives and sweethearts."

The Japanese Government, says the London Electrical Engineer, has ordered 800 miles of submarine cable from the Telegraph and Maintenance Company, this, it is understood, being intended for effecting telegraph communication between Japan and Formosa. It is said the Japanese have determined to lay this cable themselves, and that they are having a cable ship built in this country, so that they will soon be in a position to lay and repair their own cables.

Light and Power.

Japan affords a large and promising field in electric lighting and street railway work.

The Ohio Electric Light Association held its annual meeting at Piqua, Ohio, October 8.

The Canadian Electrical News remarks that "The citizens of Ottawa and of Rat Portage are boasting of their enlightenment,"—there being, it is said, in each of these places, one incandescent lamp in operation for every unit of population.

At the meeting of the American Society of Railroad Superintendents, which opened in New York City October 14, one of the important papers read and discussed was "Can electrical power be used on steam roads? Under what conditions and with what efficiency?"

An eighteen foot 50,000 pound fly wheel in the Hudson Electric Light Company's plant, of Hoboken, N. J., burst recently, scattering pieces in all directions weighing from 500 pounds to three tons. The lights all over the city went out and darkness reigned supreme.

San Francisco is being stirred to action in the direction of electric power as a matter of self-protection. Sacramento is already well provided in this respect from Folsom. Fresno is about to have an abundant supply from the waters of the Blue Lakes, and Stockton is arranging to the same end, drawing its energy from the San Joaquin River. With the high price of coal on the slope there is a material advantage from a manufacturing standpoint to the locality which can offer a cheaper form of power than is afforded by steam, and if San Francisco is to hold the prestige it has already gained, it will be necessary for it to proceed to business. There are several water-rights throughout the state that can be utilized to furnish the primary water power by which to generate the electric current for San Francisco's use, and it is well that the city of the Golden Gate is alive to the necessity of promptly grasping the situation.

Railways.

An electric railway is projected between Hamilton, Ont., and Niagara Falls.

During the past year the Manhattan Railroad Company, of New York, carried over fifteen million passengers less than it did the year before. The falling off is probably due to inefficient service.

The Chicago limited on the Pennsylvania Railroad will be equipped with storage batteries for lighting purposes. If the experiment proves a success there is a probability of it being extended to all through trains.

In a German town the municipal council when granting a franchise for an electric street railway introduced a clause fixing a fine of $500 for any interruption of service for which a reasonable excuse could not be given.

The motormen and conductors on the electric lines of the Chicago City Railway Company are petitioning for an advance in wages, and threaten to strike if their demands are not conceded. They receive at present 21 cents an hour.

India, it is said, is going into the business of railways very extensively. Already forty-five new lines are projected, which will add 6,000 miles to the present system, and others are being contemplated. There is talk of adopting electricity on some of them.

The Montreal Street Railway Company earned during the year ending September 30, $1,096,734, an increase of $214,553. Part of this is due to the natural increase in population and increased facilities, but the main cause is attributed to the increasing popularity of the electrical service.

Speaking of the development of the electric street railway in Montreal, the Canadian Electrical News cites the fact that the first electric cars commenced running there three years ago, the plant consisting of three motors. To-day 161 motors are employed and 60 trailers. The heaviest day's traffic during the present year represented 134,800, with 38,000 transfers.

An endeavor will be made to have the American Street Railway Association hold its next annual meeting in Chicago. It is needless to say that Chicago is well able to take care of such a gathering, and that a right royal welcome will await them. The matter will be presented to the present meeting of the Association by the representatives of the Chicago street railway companies.

Chicago has in contemplation the construction of an elaborate system of underground street railway for the business district, to be operated by electricity. The project is a very large undertaking, and it will be some time before it takes anything like definite shape. Meantime the need of something of the kind is very apparent in order to relieve the congested condition of the crowded streets, and an agitation will go on until some definite and practical plan is developed.

General News.

In order to encourage the introduction of the latest electrical appliances in Russia, says the Electrical Engineer, the government will admit the same free of duty for the next four years.

The German Hygienic Association, with a view to promoting something practical in the line of electric heating, has offered a prize of $1,200 for the best essay on that subject. The essays are to be illustrated by drawings.

Henry C. Payne, one of the receivers of the Milwaukee Street Railway Company, and a member of the executive committee of the American Street Railway Association, has left for Germany. Mr. Payne's health has not been very good for some time, and it is hoped his trip abroad will benefit him materially.

The Street Railway Review under date of October 15, has issued a very handsome souvenir convention number, the occasion being the thirteenth annual meeting of the American Street Railway Association, which is held this year in Montreal. The

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number is handsomely illustrated in different colored inks, and is altogether a production creditable alike to the publication and to the street railway interests which it represents.

President Garlick, of the National Association of Stationary Engineers, has resigned his position in Pittsburg, to accept that of Chief Engineer of the great Plate Glass Works at Crystal City, Mo.,—a promotion for Mr. Garlick and a subject for congratulations to the Crystal City Plate Glass Works.

Mr. Enos. M. Barton, president of the Western Electric Company, who had his leg broken some nine weeks ago by the kick of a horse, has not progressed at all satisfactorily, and has recently been removed from his home in Hinsdale to St. Joseph's hospital in Chicago for treatment under the care of Dr. Senn. Mr. Barton's many friends will join the Journal in hoping for him a speedy return to health and activity.

The Russian army authorities have decided to establish a scientific branch of the service under the direction of a lieutenant-general, two major-generals, and five officers of the lower grades, whose business it will be to work out the applicability of electrical discoveries to war purposes, says the L' Etincelle Electrique. In addition, an electro-technical school has been instituted under the direction of a major-general for the purpose of giving a 19 months' course of instruction to 85 lieutenants and sub-lieutenants of engineers. This school will also serve to train an electrical company recruited from mechanics and from selected non-commissioned officers, who, after passing through the school, will go back to their regiments and there will be available as instructors.

LEAKS ALONG THE LINE.

The Emerson Electric Manufacturing Company, of St. Louis, have issued a neat little catalogue of fifty pages, calling attention to the different specialties which they have to offer to the trade.

The Helios Electrical Company, of Philadelphia, of which the Central Electric Company is western agents, have issued a handsome little catalogue descriptive of their low potential arc lamps. It sets forth the economy of arc lighting over incandescent lamps or gas, gives directions for handling alternating arcs, and furnishes much information that will be of interest and value to users of electric light.

The American Engineer, of New York, which formerly has been published monthly, will hereafter make its appearance every two weeks. Each number will contain one-half as much reading matter as appeared in the monthly, and the price per number will be reduced to ten cents. The change is made with a view to keeping in closer touch with current events and increasing the interest of the paper to its readers.

BURTON'S ORE SEPARATORS.

The invention of George D. Burton for the treatment of ores by electricity, combined with a liquor solution, and which has been proved a complete success, is now being taken hold of by men of means in different parts of the country for the purpose of putting it to practical commercial use. To this end the American Electric Forging Company has been formed under the laws of the State of New Jersey with a capital stock of $1,500,000. The Burton Electric Company, of San Francisco, has been incorporated with $1,000,000 capital, and the Canadian Electric Forging and Smelting Company, of Toronto, with a capital of $500,000. The latter company will control the patents in Canada.

A CURIOUS TELEPHONE.

"I have a most remarkable telephone in my house," remarked a resident of the Western Addition. "I noticed that at times I could hear very distinctly the conversation in the next house. Suddenly it would be broken off short in the middle of a sentence, and I could not hear another word. It would become audible again just as suddenly.

"By a series of experiments I have found out that the sound is conducted by the water running through the pipes. When the water is turned on in my house I can hear all the conversation in any of the rooms next door in which there is running water. When I turn off the water, all sound stops suddenly.

"I told my neighbor of it and we have put it to practical use. When I wish to speak to him I tap on the window, he turns on the water in his house, and listens while I talk to him over the water pipe in an ordinary tone of voice. When I have finished he turns off the water in his house, and I turn it on in mine and listen. In that way we can carry on long conversations with as much ease as if he were in the room with me. Still our houses are about twenty feet apart."—*San Francisco Post.*

ELECTRICITY ON THE BROOKLYN BRIDGE.

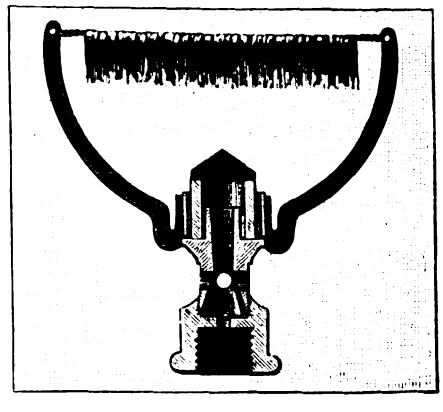
If the plan ssuggested by J. Seaver Page, Vice-President of the Board of Trustees of the Brooklyn Bridge, be accepted, says the New York World, there will be an entire revolution in the system of shunting cars at each end of the bridge.

In the front and rear cars will be placed an electric motor. This motor will control a steel bar underneath the car. As the train leaves the platform after discharging its passengers the bar, which is on a spring, will touch six little steel buttons placed at intervals along the track. The connection of the button with the bar will make the electric current strong enough to send the cars on to the shunting track and then bring them over to the outbound track again.

Instead of waiting for the engine to come and draw it to the shunting yard and then down to the opposite track, it will shunt itself. Where it now takes ninety seconds to shift a train the full time under the new system will be only forty-five seconds. It will be possible, also, to run a larger number of trains. The whole system can be put in operation before the new year.

THE HELIOGENE GAS (INCANDESCENT) BURNER.

The rage for the Auer gas burner has awakened a spirit of competition, and invention has evolved several competitors in that line. Among these the Heliogene of Mr. de Mare, represented herewith, according to La Nature, is one of the most recent.



THE HELIOGENE (INCANDESCENT) GAS BURNER.

The incandescent material is arranged in fibers hanging loosely on a platinum wire, placed in the hottest part of a Bunsen bat wing flame. These fibers or feathers are made of metallic oxides fastened at their centers by the twist of the wire. The falling of an occasional thread does not materially affect the light, which is steady and clean. The incandescent oxides are said to be very durable.

The Revue Générale des Sciences for August 30 contains articles by M. Brillouin on the "Progress of Flying Machines," by V. Dwelshauvers-Dery on the "Temperature of the Metallic Walls of Steam Engine Cylinders," by A. Gay on "Coccidia," the annual revue of pure chemistry by E. Étard, and a review of the subject of the action of high tension alternating currents on man by A. Gay. The issue of September 15 contains articles by L. Roos on the "Actual Condition of Winemaking in France;" a report of the Congress of Naval Architects in Paris in June, 1895, by L. Vivet, and, under the head of Scientific and Industrial Facts, a discussion on the measurements of slight elongations in trials of the resistance of metals by A. Gay.

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MEASUREMENT OF RESISTANCE.

The "Fall of Potential" Method—A Simple Application of Ohm's Law—Examples of its Use.

The measurement of resistance is the one test more frequently made in all branches of electrical work than any other, and, therefore, a good working knowledge of the various methods for its determination is an important part of the equipment of the electrical engineer. The most familiar, because the most generally applicable, of these methods is by the employment of a special arrangement of a galvanometer, resistance coil and battery known as the Wheatstone Bridge. This instrument, in portable and compact form, is in pretty general use for much of the practical, every-day work which comes up in connection with electrical installations of all kinds, and such a portable set is to be found among the instruments owned by a good percentage of the electric light and power companies.

But there are cases where the use of some other method of finding the ohmic resistance of a given piece of apparatus is obligatory. These may arise, either because a bridge set cannot be obtained with which to make the test, or because a bridge cannot be used from the nature of the case. The latter case is of more absolute importance, and will be taken up and illustrated in what follows. The test applicable to such cases as are about to be described is that known as the "fall of potential method," and, as will be seen, is peculiarly well adapted for use in central stations on account of its simplicity, and because the apparatus required—voltmeter, ammeter and source of current—is always at hand.

Before taking up any specific example, a brief statement of the principle of the method should be given. Ohm's law may be written:

$$R = \frac{E}{C}$$

for any circuit through which a steady current is flowing, where R is the resistance in ohms, and E the fall of potential through this resistance, or the electromotive force which is required to force through R the current C, which is in amperes. Therefore, if the coil, length of wire, lamp, or other device, whose resistance in ohms we wish to find, be connected in a circuit through which a *steady* current, like that from a battery or direct current dynamo, is flowing, and we can find how many amperes are going through it, and what the difference of potential is at the terminals, it is then easy to figure the resistance in ohms by simply dividing the observed fall of potential, E, by the current, C. Since this computation is an application of Ohm's law, the determination by this method will be as accurate as are the readings of the ammeter and voltmeter employed to find the current and E. M. F. respectively. Since the instruments in use to-day by most electric distribution companies are of a high grade, the measurement depending on them can usually be depended on as fully as near the true resistance of the object measured, as though the test had been made with a good Wheatstone bridge.

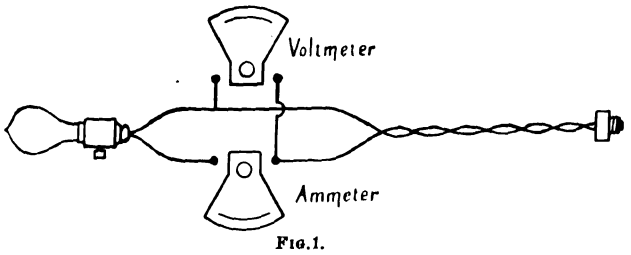

FIG. 1.

As the first example to illustrate the utility of this method of resistance-measurement, let me take the case of a 16-candle-power incandescent lamp, whose resistance while burning it is wished to find. On account of the well known fact that the resistance of carbon is lowered by an increase of temperature, it has been found that the "hot resistance" of an incandescent lamp is very much less than its "cold resistance" measured when the lamp is not burning. Hence the test must be made while the lamp is connected to its lighting circuit. Here a bridge could not be used, but if an ammeter is connected in the lamp circuit, so as to indicate the current taken from the main by the lamp, and if a simultaneous reading is taken on a voltmeter connected across the terminals of the lamp, the data is obtained for figuring the "hot resistance" of the lamp.

In the diagram, Fig. 1, the connections for the test are shown. If the lamp is supplied from a socket wired with a flexible cord to the cutout, the connection to the voltmeter and ammeter can be made by removing the insulation at a point close to the socket, and then cutting one wire of the cord for the purpose of connecting in the ammeter. The voltmeter can then be connected across the two wires: care being taken while working to avoid a short circuit by their accidentally touching together.

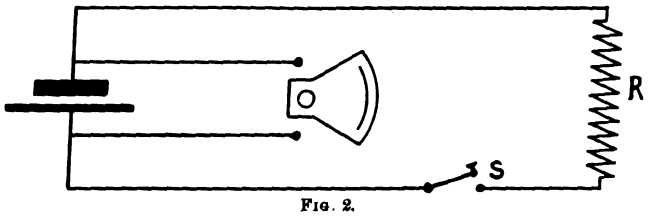

FIG. 2.

It will be seen that as the voltmeter is shown connected, it will indicate the fall of potential through the ammeter and the lamp in series. But since the resistance of the ammeter is so small as to be negligible compared with that of the lamp in this case, there will be no appreciable error introduced by thus including the ammeter in that portion of the circuit in which the fall of potential is measured. This becomes of great importance, however, in the measurement of such low resistances as dynamo and motor armatures, where the resistance of the ammeter is in any proportion to that of the apparatus under test.

Returning to our example, suppose that the lamp is being supplied from a nominal 110-volt lighting circuit, and that the indication on the voltmeter is 109.5 volts, while the ammeter, which is an instrument reading from 0 to 15 amperes, shows 0.56 ampere. Dividing the former figures by the latter, we obtain:

$$R = \frac{E}{C} = \frac{109.5}{.56} = 196 \text{ ohms, approximately.}$$

The usefulness of this method, in furnishing a simple and easily obtained measurement on an incandescent lamp under its working conditions, is apparent. As described, an ammeter and a voltmeter are required. The application of the "fall of potential" method to the determination of the resistance of batteries, however, is of at least equal value, and is even simpler in performance, as only a voltmeter of proper range is required. The test to be described below is one of the best ever devised for the purpose, and is particularly well adapted for use with storage batteries, where, on account of the large current which they generally are required to furnish, the internal resistance of the cell is of the utmost importance. The computation, like the simple operation required in the case of the test just described, is based on Ohm's Law.

In Fig. 2 is shown diagramatically a single cell of storage battery, connected to a circuit containing the resistance R, and the switch S, for opening and closing the circuit. The resistance should be about the same as that through which the cell under test regularly works, n order that the conditions of the test may be the same as the working conditions. A voltmeter of proper range, for indicating accurately the E. M. F. of the cell, is permanently connected across the latter's terminals, as shown.

The proceedure is to observe the reading of the voltmeter connected to the terminals of the battery with the switch open. Call this reading V. Since the cell is delivering no current except the extremely small amount passing through the voltmeter, this is really the total E. M. F. generated in the cell, and is called the "potential difference on open circuit." Having

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recorded V, close the switch S, so as to allow the usual working current to be delivered by the cell, and again read the voltmeter, the indication of which will be less than before. This second E. M. F., which is in reality the fall of potential, through the external circuit R, call v.

The resistance of the cell is computed from these two E. M. F. readings, knowing also R in ohms. The current in all parts of the circuit is the same. Since the pressure at the terminals of the resistance R, with the switch closed, is v, the value of the current, in amperes, must be

$$C = \frac{v}{R} \text{ by Ohm's Law.}$$

Also, if V in the total E. M. F. generated by the battery cell, and v is the potential difference at its terminals when a current is allowed to flow from the cell, the difference between V and v must be the loss of pressure in the cell itself due to its own internal resistance, which we may call r. Therefore the current in the cell itself is, again by Ohm's Law,

$$C = \frac{V - v}{r}$$

But since the current is the same in all parts of the battery circuit, we may write

$$\frac{V - v}{r} = \frac{v}{R}$$

which by ridding of fractions becomes

$$(V - v) \times R = v \times r$$

Dividing both members of this equation by v, we obtain

$$r = \frac{V - v}{v} \times R \ldots\ldots (1)$$

which is the resistance of the cell in ohms.

To take an actual example, suppose the voltmeter gave, with the cell on open circuit, 2.1 volts, and with the switch closed through a resistance of 5.0 ohms, a reading of 2.0 volts even. Then, since V = 2.1, v = 2.0 and R = 5.0 we can "substitute" these numbers in our formula, and write

$$(1) \quad r = \frac{2.1 - 2.0}{2.0} \times 5.0 = 0.25. \text{ Ohm.}$$

The one-quarter ohm thus obtained is then the internal resistance of this cell, and is very high for any storage cell but a very small one.

The two tests above described and illustrated by practical examples serve to show the usefulness of applying the phenomena of fall of potential through a resistance to the measurement of resistance in apparatus under actual working condition.

The fact that it is an accurate and frequently a very convenient method of testing, as well as the interest that attaches to it as being one of the many special applications of ohm's law, should ensure its careful study and thorough mastery by the student of elementary electricity.

J. B. Baker.

NANTASKET ROAD WORKS WELL.

"We are entirely satisfied with our experiment on Nantasket Beach business," Mr. J. R. Kendricks, third Vice-president of the New York, New Haven and Hartford Railroad is reported to have said. "The season has demonstrated the fact that cheap and frequent trains create traffic. The passenger statistics for the summer just closed show an increase of 300 per cent over those of last year, and next year we expect to do still better. The tests made the other day in the matter of demonstrating the practicability of electricity in relation to the carrying of freight were also satisfactory. The company is now looking to the equipment of the link between Nantasket Junction and Braintree. The plan that will be carried out provides for four tracks, the two outer for trolley cars and the inner for steam, and we expect to have the line in operation by the first of next season."

WHO WILL CARE FOR MOTHER NOW?

The minstrel's conundrum is to-day mixed worse than ever. "Which is the mother, the hen that lays the egg or the duck that hatches it?" might bring into the courts (if poultry have any) a question of legitimacy. But Otto Schulze, of Strasburg, has complicated the legal status of the unfortunates still more by not only hatching, but brooding poultry by electricity.

The advantages of his form of heat over that produced by combustion must be apparent to all—ohm's law settles that, and common hens are not in it.

Unfortunately there are no time dates on the two illustrations, but it may be assumed that one precedes the other by

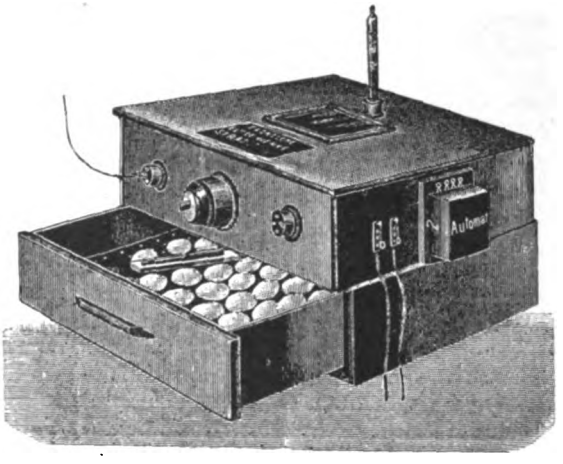

Fig. 1.
THE ELECTRICAL INCUBATOR.

about twenty-one days. Fifty eggs at a setting in Fig. 1, are shown transformed in Fig. 2 as fifty chickens.

No allowance is required for shrinkage on account of rats, skunks and weasels, floods and hail storms, and this hen never forsakes her nest.

The electrical energy required, Mr. Schulze says, is, for fifty eggs, from ten to twenty watts, governed by the outside temperature and the critical period of the electrical mother. He tells us also that she (electricity) can hatch and bring up pheasants, partridges, ducks, geese, etc. The hatching heat of this mother to the motherless is kept automatically within one-tenth of a degree Centigrade, and the proper saturation of the air is also kept uniform.

When the orphans are brought into the world, a box nurse

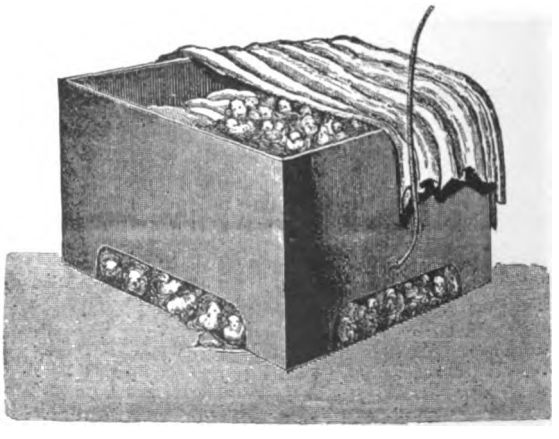

Fig. 2.
THE ELECTRICAL BROODER.

takes charge of them, and their good mother warms them in the nursery on the first floor, while the basement serves as play ground and dining room. When their little footsy-tootseys get cold down stairs they can run up to the nursery and warm them, and one more innovation is scored for electricity.

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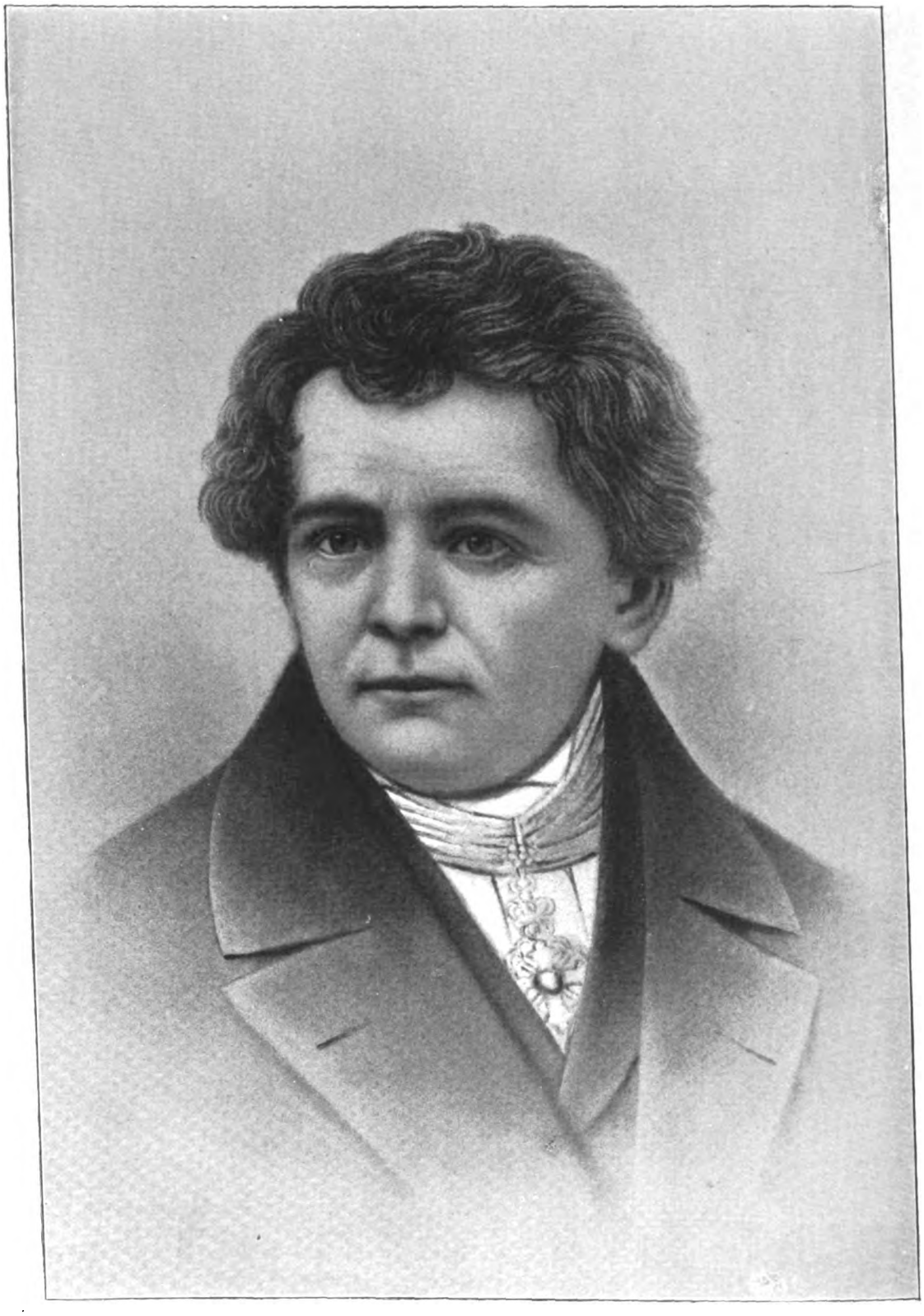

GEORGE SIMON OHM.

Professor of Experimental Physics in the University of Munich. Born at Erlangen, 1781. Died, 1854. He Discovered the Law of Electrical Resistance, now known as Ohms Law.

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The Electrical Journal.

Vol. 1. CHICAGO, NOVEMBER 1, 1895. No. 11

STREET RAILWAY CONVENTION.

Fourteenth Annual Gathering Held at Montreal a Success—Business and Pleasure Profitably Combined—Large Attendance of Delegates.

NEXT MEETING WILL BE HELD IN ST. LOUIS.

The Fourteenth Annual Convention of the American Street Railway Association held in Montreal, from October 15 to 19 inclusive, is conceded to have been a successful one. About seven hundred members, supply men and ladies from all parts of the United States and Canada took part in it.

The Association met for the first time in business session in the big Windsor Hall, on Tuesday morning. The time announced for its convening was ten o'clock, but it was fully half-past eleven before the session was called to order by Mr. Joel Hurt, the president. This delay was due to several reasons, chief among them being that the Executive Committee had not completed its work. Then, too, there was a decided disinclination among the delegates for getting down to work. They stood around the rotunda of the Windsor in twos and threes and in groups, shaking hands with old friends and making new ones. The supply man was everywhere, and he could always be told by the little yellow button worn in the lapel of his coat. These buttons which had been distributed at the Information Bureau, which was established in room No. 2, were of a varied assortment to meet all demands; purple for the delegates; yellow for the supply men, and a small pin with a blue face for the ladies. These were the open sesames which admitted everywhere, including transportation on both the Montreal and Park and Island Railways. The entire morning additional delegates kept filing in. A special train of eight cars carrying a delegation, arrived at the Grand Trunk Station at ten o'clock. They were met at Montreal Junction by Mr. A. J. Corriveau, of the Park and Island, and Superintendent McDonald, of the Montreal Street Railways. All day, conductors and motormen of the companies, in full uniform, gloved and burnished till they looked as if they had just come out of a band-box, waited on all trains and rendered such service to the arriving delegates as was found needful. Then, too, they acted as ushers when the convention opened. It was like drawing teeth to get the delegates into the hall, and when they did assemble, not over one-fourth of the chairs were occupied. The platform at the opening of the session was occupied by Mr. Joel Hurt, of Atlanta, the president, and Mr. John A. Partridge, of Brooklyn, the secretary *pro tem.* The session opened with the president's address. He said in substance: "We are for the first time in convention beyond the confines of the States, and by this meeting on Canadian soil the lesson is taught that the Association is endeavoring to extend and receive the benefits of fraternal intercourse and broad educational work. It is hoped that the delegates will enjoy their visit, but it should not be forgotten that we are meeting also for useful practical work." He referred to a number of papers presented at the last annual meeting. The street railway question, he said, was rapidly attracting a study of its solution and receiving more than ever before the attention of educated men. The question had become an all absorbing one. There are, he said, in operation to-day in the United States 179,300 miles of steam roads, and about 13,500 miles of street railways. The passenger receipts of the steam roads for the past year amounted to $276,031,000. The gross receipts of the street railways were between $125,000,000 and $140,000,000. This made the street railway passenger receipts about 45 per cent of steam road receipts. The total capitalization of bonds, stocks, etc., of steam roads in the States were about $11,000,000,000, of street railways about $1,300,000,000. The profits of steam roads were $322,000,000, of street railways $43,000,000. These figures served to show the magnitude of the business. Among the questions coming up for extended consideration are the handling of freight and mail, the delivery of small parcels from retail stores, and the handling of building materials from and to suburban localities, and the operation of funeral cars. Friendly legislation for transportation is also to be looked into. The inquiry is also started as to the advisability of amalgamation of steam and other motive power. But after all the great point is to enlarge the scope of the organization. "The Executive Committee has held three long sessions—two in Montreal and one in New York—and seven days and nights have been spent in the work," Mr. Hurt said, and they had not yet completed their report and they would be obliged to ask further time to perfect it.

Upon the motion of Mr. W. Worth Bean the reading of the minutes was dispensed with, and the report of Mr. John A. Partridge, the secretary, was read. This report was not altogether satisfactory, as it showed a deficit. The total receipts were shown to be $7,062.25, and the expenditures to have been $7,040.61, between October 15, 1894, and September 30, 1895.

At this juncture in the proceedings Mayor Villeneuve, Colonel Stevenson and the Mayor's secretary, Mr. Rene Beauset, made their way into the hall, and amid applause proceeded to the platform. His Worship, in welcoming the association, said he was fulfilling a most pleasant duty. He recognized that as a body it was one of the most important on the continent. The electric industry had grown and thriven until it had assumed dimensions upon which people looked with admiration and wonder. He said that he considered it a great favor to be able to bid them welcome on behalf of the city of Montreal. In reply to the Mayor the president said: "Such generous words of welcome gives us full license to enjoy all there is to be seen and participated in. The members of the association, he said, were called upon daily to decide grave and important questions, and he extended a hearty invitation to those who were interested to be present at all the Association's deliberations. Col. Stevenson was then introduced. He said he had just come from a trip extending over 2,850 miles, and attended a not very pleasant meeting of the council the previous evening, so he thought it was not fair of the Mayor to take him along, but he assured the delegates that the welcome extended was well meant. He knew electric railways did not always work so much for the people's interest as for their own, but he was not sure that they were to be so much blamed for that. He felt sure, he said, that the Association was in good hands, and that if the Montreal Street Railway would treat them as well as it did the citizens, they would have no cause to complain. When in

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Augusta, Me., he heard the delegation was a very dangerous crew, but he felt there was no reason to be afraid of them. If there was anything that they wished him to do as a citizen, for he did not think, perhaps, his introduction as an alderman was the best of recommendations, they only had to say so. "Mr. Lusher and Mr. Cunningham have not been very backward," he said. "Follow their example and go back with pleasant recollections of your stay."

The subject of transfers was the next order of business. This, however, could not be taken up, owing to the gentleman who had papers on the subject not being present. Upon the motion of Mr. C. D. Wyman, of Milwaukee, the session was adjourned till the afternoon.

AIR BRAKES.

At the afternoon session of the Convention the discussion of power brakes versus hand brakes was taken up. Mr. E. J. Wessels read a paper on the subject. He said there was great necessity of testing air brakes, not only in the shops but on the cars, and called attention to the difficulties in the way of devising a practical air brake, among which he included lack of space under the car, lack of knowledge on the part of the motorman, and the probable absence of adequate inspection and lubrication. He also referred to the fact that an efficient brake is desirable at any price, and should always be insisted upon in preference to a cheap device of doubtful efficiency. The success of the automatic system used on European roads he ascribed to a rigid expert inspection. The air brake was set forth as an ideal among power brakes. Mr. Wessels called attention to the necessity for patience and perseverance in the application of power brakes to motor cars. Trained motormen were, he said, especially to be desired, and were easily obtained in this country. Cost was set aside as a secondary consideration in adopting power brakes. He said that users and manufacturers should co-operate in the production of a good brake.

Mr. McCulloch stated that an otherwise successful air brake in St. Louis had been discontinued because of excessive repairs, and Mr. Wessels replied that though this was true it did not argue the impossibility of constructing a brake that would give the proper results in this respect.

Mr. Harry Scullion, of St. Louis, stated that he had trouble in the use of air brakes in crowded sections. He could not keep up pressure in the train pipe, owing to the frequent use of the brake. He also stated that the hand brakes became disabled. Mr. Wessels explained that these troubles were due to the defective design of the brake used.

PAVING.

The topic of paving was next discussed. It was asked if it was necessary to abandon operation during paving, and a negative answer was given by several speakers. Mr. McColloch, of St. Louis, said that several of his lines were being repaired with different kinds of pavement, and that the street railway traffic was not hindered. He questioned whether local authorities would allow the company to suspend operations.

The session was then adjourned.

At half past three o'clock in the afternoon a party started in a special car from the Windsor to the City Hall. The party included the Executive Committee of the Association and the local reception committee. An invitation had been extended by the Mayor and City Council to attend a reception. The local committee consisted of Messrs. Granville C. Cunningham, L. J. Forget, Dean Bovey, P. W. St. George, J. F. Hill, K. W. Blackwell, J. R. Roy, chief engineer of the Montreal Park and Island Railway; E. Lusher and D. McDonald.

The party was received in the Council Chamber by the Mayor and Aldermen Farrell, Prefontaine, Stevenson, McBride, Savignac, Smith, Nolan, Penny, Marsolais, Connaughton and Renault.

Mayor Villeneuve proposed the toast of the American Street Railway, and said he was glad that the members had come here to discuss the advantages to be derived from their system. The citizens of Montreal appreciated the electric system which was established here now. For years previously fault had been found with the Street Railway Company, and, as his friend Col. Stevenson would say, with good cause, but things are changed. The present administration was giving employment to between 1,500 and 2,000 people, and citizens were traveling at low rates. Referring to the question of transfers, the Mayor said that he saw it was to come up for discussion at their convention, but he did not think it was right that the public should ride all day for nothing. His Worship hoped their sojourn would be pleasant, and he trusted their deliberations would be advantageous to themselves, the companies they represented and the public at large.

General Jackson, of Nashville, was the first to respond. It was a great pleasure to him personally, he said, as this was the first time he had been on British soil. Of his visit and reception here he would carry back pleasant memories. The street railways had been a great benefit to the poorer classes, and they had also been instrumental in bringing the suburbs in closer contact with the cities. The greater the individual prosperity, the greater that of a city. He also congratulated Mr. Cunningham on the perfection of the arrangements for their reception. Concluding the general said: "Here is champagne to our real friends, and pain to our sham friends."

Mr. Stedmont, of Rochester, N.Y., followed in a similar strain, and there were calls for Col. Stevenson, but he gave way to Ald. Prefontaine, who also expressed pleasure at seeing them in convention here. He referred to the change of system from horse cars to electricity here and he thought the citizens had reason to be proud of the change. He also referred to the removal of snow in the winter time, which many had thought was an impossibility, but the administration had faced the music like men with courage and had overcome the obstacles with success. He did not think that any othey city in this country had the same difficulties to contend with, although they might have in Russia. He also touched upon the passing of the street railway by-law, which engaged the attention of the council for six months, and at that time Ald. Stevenson was a member of the loyal opposition.

Ald. Stevenson held that good had resulted from that opposition, as was evidenced by the good service of to-day.

After a pleasant half hour's chat the visitors withdrew.

WEDNESDAY'S SESSION.

It was a little after ten Wednesday morning when Mr. Joel Hurt, the president, called the meeting to order. After a few minutes discussion the members went into executive session. Those wearing purple badges were invited to remain and the remainder invited to leave. It seemed hard work to even get a quorum, for two or three members were to be seen here and there in the Windsor rotunda inviting delegates to go into the hall and take part in the proceedings.

That most of the members were more interested in the exhibit of supplies in the Victoria Rink than in the busidess of the Convention was conclusively shown. While the hall was nearly empty, the Victoria rink and other places in the immediate neighborhood where exhibits were installed were largely attended.

All the booths were handsomely decorated, and arc and incandescent lights helped to enhance their appearance. The display of appliances of all kinds was indeed complete, and in addition to forming an attractive feature of the Convention, resulted in quite a number of important sales being made.

Throughout the entire day Wednesday the members were in executive session. A large number of the delegates and their ladies, with the ever present supply-men flocked to the Science Building at the McGill University to see the latest improvements whereby science has succeeded in making chain lightning subservient to humanity.

Naturally there were a number of invited guests who neither had an interest in street railways, nor a clear insight into the mysteries of electricity, and these furnished considerable amusement for the practical men. Some of the unsophisticated took their life constantly in their hands by the supreme carelessness

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with which they moved about, and there was a constant fear that some one would try to modernize the ancient tableau of Ajax defying the lightning. The guests were received at the Engineering Building by Dean Bovey, Prof. Nicholson, Mr. C. Wilson, electrical engineer, and Mr. W. Carlyle, mining engineer, These gentlemen, particularly Dean Bovey and Prof. Bamford were assiduous in endeavoring to make the visit a pleasant one to their guests. They were shown everything to be seen in the building, and the electrical machinery and testing apparatus were set in motion for their entertainment.

The testing laboratory was the first place to which they were conducted, and here, after they had witnessed various interesting tests, they were addressed by Prof. Bovey, who welcomed them. The faculty, he said, were always delighted to meet visitors such as the present company. The visit of practical men helped them along wonderfully in their experiments. He dwelt on the generosity of Mr. McDonald in presenting the electrical building to McGill, and also referred to the exceeding kindness of a great many firms from the United States. "When the electrical convention was on four years ago," he said, "our electrical building was just completed, but, beyond one dynamo, our equipment was meagre and principally conspicuous by its lack of instruments. The representatives of the various States companies showing at the exhibition came and looked our building over, and when they left the city we were fully equipped. They came with their hands full and left with them empty."

General Jackson, of Nashville, Tenn., made a very brief reply, which principally consisted of a suggestion that as the subject under discussion had been rather dry they adjourn to the second floor, where, as Prof. Bovey had assured them, refreshments were waiting. The suggestion was acted upon, after which the visitors roamed about the building to their heart's content.

THURSDAY'S SESSION.

At eleven o'clock Thursday morning the executive session of the Street Railway Association was at an end and the regular programme was continued.

The report of a special committee appointed at the previous year's convention was submitted by Mr. F. R. Green, of Chicago. The report had to do with the best method of protecting the members of the Association against "patent sharks," who insist upon royalties for the use of appliances, when, if the matter were properly looked into, it would be found that they had no legitimate claim. Mr. Green, on behalf of the committee submitted the following proposition: First, provided the members vote to increase the scope of the Association, they recommend that a bureau be established to handle all matters pertaining to patents; and, second, provided it is not deemed best to enlarge the scope of the Association at this time, they recommend that the Association pass a resolution providing that the annual dues be divided into two classes, regular and special; that all members be required to pay the regular dues as already provided in the by-laws, and that it be optional with members to pay the additional and special; that members paying special dues will be entitled to all the benefits to be derived through the agency of a patent bureau, to be established and under the direct control of the Association.

Mr. John A. Seeley, of New York, then introduced a motion expressing the cordial sympathy toward the projected National Electric Light Association, which meets in convention in May, or June in New York City. Mr. E. H. Davis, of Williamsport, Pa., who seconded the motion, said that he thought the coming convention should have the cordial support of the Association. It was to be an affair in which the Association was virtually interested, and features would be introduced which were new in the electrical world.. The motion was unanimously adopted.

At 11:30 a recess was taken in order to allow the reports of the committees to be completed and presented.

The following is the official report of Wednesday's secret session, which was read. The first topic on the programme for discussion, the "Labor Question," was taken up, the discussion being opened by Mr. Wyman, who was followed by Gen. Jackson. The discussion was suspended to admit of the reading of a communication from Mr. Baumhoff, of St. Louis, enclosing a paper on transfers. Both letter and paper were read, and, on motion, the paper was ordered to be spread on the minutes and printed. The discussion on the question of transfers was opened by Mr. Sargent, who was followed by Messrs. Charlton, McCulloch, Jackson and Hurt.

The chair accorded to Mr. Harrison the opportunity of making an explanation which he desired to make respecting his nonconcurrence with the majority of the Executive Committee upon some items embraced in their report. This was followed by a discussion in which Messrs. Harrison, Hamilton, Jackson McCulloch, Thompson, Hurt, Cunningham, Wyman and Fairchild took part. Finally, on motion of Mr. Wyman, it was agreed that the report as read by the Executive Committee be spread in full on the minutes, and that a copy thereof be sent to each member of the Association, and that action thereon be deferred till the next regular meeting of the Association.

The following resolution, proposed by Mr. Littell was adopted: That a committee of seven be appointed by the chair to nominate officers for the ensuing associational year, said nominations to include nominations for the executive committee. Further, that said nominating committee shall recommend in their report a place of meeting for the next gathering of this Association.

Mr. Harrison moved that a committee of ten be appointed by the chair to devise ways and means for raising the deficit. The motion was carried. The most exciting, and perhaps the most important meeting of the convention was held in the afternoon, brought about by the report of the Committee on Ways and Means, of which Russell B. Harrison was president. The Association was $4,087 in debt, and the report suggested the admission of associate members, without voting privileges, upon payment of $15 as an annual fee, and that, to prevent a recurrence of a deficit, the practice of giving tickets to the banquet be discontinued, but that a charge of $5 be made for these. Already the committee said they, by private canvass had been promised $2,000 of this amount, but the whole procedure was with a view to using the unpleasant predicament in which the Association found itself, as an excuse for letting in supply-men, to which attempt Mr. Harrison, as he afterwards admitted, had pledged himself. Mr. Thompson, of Gloucester, started the fight which was to end in leaving matters as they were and the supply men out. He vigorously opposed the proposition to let outsiders in, and was followed by Mr. Hamilton, who, for the information of the meeting, stated that with the new liabilities incurred by this convention, the total debt would amount to about $6.000 Mr. Ackerman next took the matter up, and spoke a good word for the supply-men. They had been treated shabbily enough in the past, and it should not be forgotten that Walter Jones and Brill, the supply men, and as fine men as could be found anywhere, had founded the Association. Then President Hunt left the chair, and took a hand in the discussion. "The idea," he said, "of the American Street Railway Association, representing a billion three hundred million dollars worth of property, asking others to join them and pay their debts was preposterous. The resolution contained a badly ridden Trojan horse, which, if allowed within the gates, would break up the Association in no time. I am sure the supply-men don't even want to come in. They are gentlemen and don't want to mix in our family affairs. We would have no time whatever to do business if they were admitted to the convention, where they could button-hole us about trade at all times. The clause put in the report, forbidding supply-men to vote is a delusion and a snare, for if they can't vote, they can chin, and in the great crowd which would be present it would be impossible to see who had a right to vote and who had not. If we admit the supply-men into our family we will break up. They are nice men, and I wish to treat them well. I would like to treat them at the Association's expense instead of charging them higher than ourselves, as we have been doing; but don't let us bring them in at the discussion of our private affairs.

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Why, if we did, our members would refuse to talk in future. They only do it now because they are assured that our executive sessions are secret. Supply-men are well enough in their way, but they had all had the experience of other ways, in which they were not. His company, for instance, had lost thousands of dollars by supply-men who had built roads in opposition to his by furnishing material in return for the bonds. There were four of these roads, and though they had all come to a bad end, they had created much annoyance during their existence. The entire report showed that Mr. Harrison, was under some obligation to these men, when, as he said, he had pledged himself to bring them in." Mr. Harrison immediately denied this imputation. He had only said that he was committed to bring the proposition for the admittance of supply-men before the convention. As to secret sessions, he did not believe in them. In the United States the only important body that held secret sessions was the senate, and even they could not keep the result of their deliberations from the newspapers. Mr. Greene backed up Mr. Harrison, and was also in favor of the supply-men. They were the men to spend the money, which did not cost the convention a nickel. He reproached Mr. Hurt for not having seen the report referring to the supply-men a year ago, and for one he would not be president of an association if he did not know all its business. It seems he labored under a misapprehension, however, and that Mr. Hurt really did not see the report. Then a most unparlimentary scene took place. Mr. Bean, the first vice-president, aided and abetted in a most amusing manner in the breaking of all parlimentary precedents, his maxim being "Business is our aim, whether done in a parlimentary manner or not." It was suggested that the report be taken up seriatim, and, among others, supporting this motion was Mr. Seeley, of the Lockhaven Railroad Company, who was promptly asked what road he represented, and who as promptly replied, that though it was a small one, he was prepared to give a hundred dollars towards the paying of the liability without any condition whatever. This immediately brought others to their feet, who offered to pay one-twentieth of the total debt each, if the whole were paid. About a dozen others cried out that they would give a hundred dollars each. There was a babel of voices and the chairman was continually compelled to tell them that they could not all talk at once, and that they should not mistake the convention for the United States Senate. After much talk and many motions which were out of order, and among which was one proposing that supply-men be called in and asked to speak for themselves, the entire report of the Committee on Ways and Means was dropped seriatim by votes of 41 to 18 and 37 to 6 respectively. Mr. Dodge, from New Haven, then proposed that everyone be asked to contribute $15 for every $100,000 of annual income. But this was objected to, because many companies do not want their income known. Finally Mr. Hurt's motion to ask, first, for $100 subscriptions, then for $50, then for $25 and then for $15, was adopted. This started a flood of contributions bewildering in its volume and swiftness. The hundred dollar ones started by a large list of contributers from St. Louis as follows: Union Station, Linden Missouri, St. Louis, Citizens, Cass Avenue, Chicago City, Covington and Newport, West End, Woodbury, Atlanta, Lockhaven, Williamsport, Minneapolis and St. Paul, Wilkesbarre, Reading, Cleveland, Louisville, Lehigh, Southern of St. Louis, North Chicago. This made a total of $2,200. Then came the $50 ones: Brooklyn, Columbus, Consolidated of Worcester, Citizens of Indiana, Hartford, Terre Haute, Globe of Fall River, Troy, Omaha, Patterson, Scranton, Union of Providence, Bridgeport, Buffalo, Newark, Brunswick, Winchester and N. H. Manchester, Montreal, Ottawa, Taunton, New Haven, St. Joseph, Alton, Wayne, Tampa, Fla.; Des Moines and Camden. This made an additional total of $1,400. Then permssion was given to roads to increase their subscription, and increases came in as follows: Union Depot, $100; Montreal, $50; Chicago, 100; Minneapolis, $100; St. Paul, $100; Atlanta, $50; St. Louis, $100; Missouri, $50; Milwaukee, $50, and West End, $50. This brought the total to over $4,000 in no time, and the companies not present were given the right to contribute.

NEW OFFICERS.

The Committee on Nominations reported the following list which was unanimously adopted:

President—H. M. Littell, Brooklyn.

First Vice-President—Granville C. Cunningham, Montreal.

Second- VicePresident—Gen. W. H. Jackson, Nashville, Tenn.

Third Vice-President—J. Willard Morgan, Camden, N. J.

Secretary-Treasurer—T. C. Pennington, Chicago.

Executive Committee—Joel Hurt, Atlanta; Prentis Cumming, Boston; C. G. Goodrich, St. Paul; Alvin Markle, Hazelton, and W. F. Kelly, Columbus. St. Louis was chosen for the next place of meeting.

The following motion was passed just as the meeting closed: Mr. McCulloch, of St. Louis, stated without thinking how he let the cat out of the bag, that Mr. Cunningham, of Montreal, was very anxious to have it placed on record brfore the convention adjourned. It was the finding of the Special Committee on the use of salt and sand on the streets in winter, and the committee reported that the use of these was absolutely necessary, the salt to take a film of ice off the rails, and the sand to enable the wheels to obtain a grip.

In the evening the banquet took place. It was almost international in its character, for in the banquet room were to be found types, and brilliant ones too, of men and women from both continents and many countries. As Senator Ogilvie said in his toast, it was an assemblance of brains and beauty—of bright men and handsome women. The tables were laid in the beautiful dining-room of the Windsor, which had been specially decorated for the occasion. The banquet tables were nine in number, eight of which ran parallel throughout the room. At the head of these and running the length of the dining-room was a ninth table, at which sat the toast master, and the speakers of the evening. In the centre, over the chairman's head, was a stand of British and United States Colors. The letters "A. S. R. A," in blue

NEW OFFICERS FOR THE ENSUING YEAR.

H. M. LITTELL.
President.

GRANVILLE C. CUNNINGHAM,
First Vice-President.

GEN. W. H. JACKSON,
Second Vice-President.

T. C. PENNINGTON,
Secretary-Treasurer.

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and gold above, and the word "Welcome" in the same colors below. At the end of the room were stands of colors, British and United States, and upon the tables potted plants. The most brilliant decorations in the room, however, were the ladies in their brilliant costumes. Mr. Joel Hurt, the Past President of the Association, acted as toast master. On Mr. Hurt's right was Sir Alexander Lacoste, and on his left the Mayor of Montreal. Next to Mayor Villeneuve and Senator Ogilvie, and second upon the chairman's right was Dr. Anderson, United States Consul-General. Mr. Worth Bean, of St. Joseph, Mich.; Hon. Louis Beaubien, Minister of Agriculture; Col. J. H. Cunningham, of Boston; Mr. John H. Stedman, of Rochester, and Alderman Stevenson were also at the toast master's table.

After the menu had been disposed of Mr. Joel Hurt, as toastmaster, said, upon rising to introduce the toasts, that every year the members of the Association and their friends and foster-brothers, the supply-men, met at their annual banquet. It was pleasant, he said, to meet friends and take them by the hand and greet them as brothers. It was a double honor to see the banquet board graced by the fair sex.

After the toast of Her Most Gracious Majesty Queen Victoria, which was received with great applause, the next toast was that to the President of the United States, and was drunk amid the strains of the "Star Spangled Banner." Dr. Anderson, the United States consul, responded. He said he had been informed that all the American gentlemen had been shaving with ice water that morning. "I am virtually a stranger to you although you are my countrymen, but with the Montrealers it is different. They know me well and are a long suffering people on that account. How well they know me is shown by the fact that a party of students once waited upon me and asked me to please come as they did not expect much of me. There was a case of reputation preceding one. It is not so in this case. I have been familar with both the Democratic and Republican parties, but I never ran against the trolley party. I am not familar with the currents and counter-currents that reign here, and I run considerable chance of running up against a live wire. I thank you for the manner in which you drank this toast. You did almost as well as the Canadians, and it was drank with more enthusiasm than it is usually drank in the United States, for there are always people to whom the wine would taste sweeter if some one else occupied the executive chair. That is the great trouble of our continual political changes and upheavals, which makes me in favor of a longer term. You could not have come to a better city, a city which is more ready to entertain and welcome strangers, especially from the United States. Montreal has all that can make a town pleasant and interesting, and when I say so I want you to understand that I have no axe to grind. I am no city official, and I have not even a magic button." Dr. Anderson then told several funny anecdotes and was followed by Mayor Villeneuve. The toast "The City of Montreal" was responded to by the Mayor. He said that he was glad that they had been honored by the assemblance of the convention. It was good to see in Montreal these men of progress. Of the Montreal Street Railway men the city was as proud as the gentlemen were of the city. He hoped that before many years they would again have the pleasure of entertaining the convention. The next toast was to the American Street Railway Association. Mr. Hurt introduced the toast something like this: "Less than two years ago it was the good fortune of the Association to welcome into its ranks a gentlemen honored in years, honored in fortune and because he had served his country, and we expected him to reply to this toast. I refer to the famous owner of the Belle Meade farm of Nashville, Tenn., General Jackson, but unfortunately he has been called away from here this morning. But we have acquired a new member in Montreal, and he will take General Jackson's place." Then Alderman Stevenson stood up and replied on behalf of the great Association. He said he had been in many difficult situations, but never any like this. He never was either a stockholder or a director in any street railway company, but he had been the first passenger on the first car which the Montreal Street Railway Company ever ran. He referred to the great friendship existing between the Dominion and the States, and finished with a few graceful words, complimentary to the consul-general. The Hon. Louis Beaubien proposed the health of the retiring president. Mr. Hurt, in reply, referred to the honor he felt at thus being toasted as the president of an association, the members of which daily carry millions of people, and who in seven years have transplanted the slow and unsatisfactory horse-car service. "The Montreal Street Railway" was responded to by Mr. Granville C. Cunningham, of the M. S. R. He said that when Col. Stevenson told of all the good things of Canada he forgot to tell that it was to the United States that we owe the electric system of to-day. You have been our teachers, and I hope I may say friends. He hoped they would again be seen in Montreal. "Our Guests" was responded to by Sir Alexander Lacoste, who said he felt honored to be present if it were for nothing else than to say "thank you." He did not mean to say that as a chief justice, but simply as a citizen who appreciates the great work the Association had done, probably the greatest of the age. He was glad at the good feeling which exists between Canada and the nation which is keeping so conspicuously in the van of progress. As a man whom the law forbids to make any more money during his life, he took another view of the tramway than those about him probably did. He took the view that the tramway had done a greater benefit to the poor than to the rich, and the former, like the latter who drive in their carriages, could now enjoy life. "I congratulate you," he said. "You are making money, but at the same time you are doing good work for the poor." Senator Ogilvie said: Above all things we have to thank our friends from the United States for bringing the ladies. What struck him, he said, in looking over the Association was to see what a fine-looking lot they were. Cultured, refined and intelligent, probably more so than could be found anywhere else. In spite of a few hot heads on both sides of the line, there could be nothing that would precipitate us into unfriendly feelings.

Mr. John H. Stedman, of Rochester, N.Y., replied to the toast of "The Ladies." "The Technical Press" was replied to by Mr. Chas. Dudley Price, editor of the Electrical Review, and "The Press," by Mr. Arthur M. Burns and Mr. Sauvalle,

FRIDAY'S MEETING.

The meeting on Friday was called to order at half-past ten o'clock by Mr. Joel Hurt. He explained that owing to the absence of the delegates who were to prepare papers, the reading must necessarily be dispensed with. This, Mr. Hurt explained, was owing to the fact that the gentlemen had not sufficient time for the preparation of papers. This had been owing to the illness of the secretary.

The experience of roads in furnishing entertainments and other relative subjects was taken up. The discussion was taken part in by representatives of several roads. Mr. Hurt thought that the public were more on their nerve at the time of excursions, and that the public, even if incommoded or even slightly injured at such times, would not, as a rule, complain to the company. Being more on the qui vive they would escape when otherwise they might have been injured.

Mr. T. C. Pennington, of the Chicago City Railway, stated that very large crowds did not militate against this. On Chicago day during the World's Fair they had carried upwards of 800,000 passengers, and the only accident reported was a broken arm. "Car Heating" was taken up by Mr. Jas. F. McElroy, of Albany, N. Y. This was explained by Mr. McElroy with a series of diagrams. He proved himself a perfect master of the subject of car heating. The newly-elected president, Mr. Littell, and secretary, Mr. T. C. Pennington, were then conducted to the platform, when both thanked the convention for the honor conferred. The following resolution was then read and adopted by a standing vote:

Resolved, By the American Street Railway Association, in convention assembled, that the members express their heartfelt appreciation of the many acts of hospitality and courtesies

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extended to them by the citizens of Montreal, and by the officers of the Montreal Street Railway, and that we give the assurance to both of a grateful remembrance. We came among you as strangers and found in your homes and hearts a hearty welcome and a loving corner—a greeting long to be remembered, and the separation that now comes will long be regretted. To one and all we extend a hearty invitation to our next meeting, when we hope to extend our best welcome. Signed—H. M. Watson, D. G. Hamilton, E. S. Goodrich, Committee.

Among other attractions, Friday, was a trip tendered the deldates by the Park and Island Railway, and notwithstanding the exciting time at the afternoon meeting, enough members absented themselves, with their ladies, to fill three of the large, comfortable and handsomely decorated cars of the company. The party was particularly in charge of Hon. Louis Beaubien, the president of the company, and Messrs. A. J. Corriveau, Holgate and Roy. The cars made excellent time, and the delegates not only enjoyed the trip itself, but were much pleased with the scenery en route. A stop was made at the old snow-shoe resort, back of the mountain, where refreshments were served. Saturday was devoted entirely to pleasure. At 7:30 o'clock fully one hundred and seventy-five ladies and gentlemen assembled at the Windsor Station. They had gathered to participate in the excursion to Ottawa, which Mr. Jas. Ross, vice-president of the M. S. R., had tendered to the members of the American Street Railway Association and their friends. A train of ten cars had been provided, and in a few minutes the cars were comfortably filled with as jovial an assemblance as ever went excursioning. Upon the arrival of the party at Ottawa they were met by a local committee composed of some seventy-five ladies and gentlemen, numbering among them the members of the Cabinet, the Mayor of Ottawa, and Sir Mackenzie Bowell, Premier of Canada. The party were escorted to a gaily decorated train of eight handsome cars of the Ottawa Electric Railway Company, which stood in waiting, and all proceeded directly to the Parliament Buildings. In the Senate chamber they were received by the Premier and welcomed by him in a most happy manner. He said: "It is a great pleasure to greet you in the Senate Chamber of Canada's Capital. It is one year ago that Sir John Thompson, my distinguished predecessor, addressed a similar gathering—The International Mechanical Engineers. It is my privilege to-day to welcome you to a city where the electrical facilities are not excelled by any place in America, aided as they are with the tremendous water power which it is their fortune to possess. No studious man will wonder at any new development which may take place in the electrical world. Nothing but good could come of such a meeting as this is. We are your neighbors, and we have but one desire, and that is to live in amity and peaceful rivalry with those across the line. Again I welcome you to Canada, and most cordially hope that your studies of our country and our electrical development may be fruitful and the source of much pleasure." Mr. Granville C. Cunningham then arose and introduced Senator Galliner, of Manchester, N. H. The senator's speech was a most stirring one and brought forth rounds of applause. He said that in the United States Senate there was no previous question, but it was always a question when they got through. In his case, however, he would be brief. "Few, if any, of those present had ever visited Canada before," he said, "and we come to cultivate the feeling of amity and good-will which exists between the two nations. War between us is over forever. The monuments of battlefields are the monuments of valor to both you and us, and they are but memories of the past. There may be arbitration, but there will be no more war. There is room on the great North American Continent for two great nations. It is your mission and our mission to build up the welfare of the great human race. I appreciate the kind welcome we have received on Canadian soil, and doubly so that it has fallen from the lips of so able a representative of your great country."

After a view of the Parliament Buildings, the party were escorted to the Russell House, where a fine luncheon was served. After luncheon the street cars were again taken and a trip to Rockcliffe Park and the power house of the company, was indulged in. At exactly 3:45 o'clock the street cars brought the thoroughly delighted excursionists again to the railway station, where they embarked for the homeward trip, arriving in Montreal at seven o'clock.

Other members of the Association and of the Montreal Hunt were entertained at breakfast at the Forest and Stream Club, Dorval, by Mr. L. J. Forget, president of the Montreal Street Railway Company on Saturday. A special train left Bonaventure Station at half-past nine o'clock, and about a hundred and fifty members of both organizations availed themselves of the invitation. It was probably the largest meet that has ever taken place in the history of the Club, and the combination of Mr. Forget's lavish hospitality, the large number of riding members and the successful issue of the chase itself, in which the two most conspicuons people in the field, Mrs. Col. Strathy and Mr. Joel Hurt, the ex-president of the A. S. R., captured the first trophies respectively, was such as to send the Americans home with the best possible opinion of the sports and recreations of Canada's best people. At three o'clock the master concluded to call the hounds off, and a move was made by the field in the direction of the Forest and Stream Club, where they partook of a most enjoyable lunch, after which an hour was spent making speeches and singing hunt choruses. After lunch had been disposed of, the toasting commenced. The master proposed the health of Mr. and Mrs. Forget, which was received with enthusiasm. Mr. Baumgarten proposed the health of Mr. Hurt, the master of the Atlanta, Georgia, hounds. "The Master," was proposed by Mr. Hurt, who said that he had never seen such a field of good riders. He had enjoyed himself thoroughly, and was proud to have captured the mask. The hospitality of the Montreal Hunt should never be forgotten by him. If any of its members ever found themselves in the vicinity of Atlanta, they were invited to join the Atlanta hounds on one of their runs.

In the evening nearly all the delegates left for home.

MONEY TO BURN.

Confederate Bills Otherwise Worthless Used In Making Electric Light Carbons.

"Did you ever know what has become of the greater part of the confederate paper money with which this country was flooded some years back?" asked a local business man who had just returned from a trip to the Atlanta Exposition. "No? Well, neither did I until I struck Atlanta a few weeks ago. In that town I found an old man who makes a business of quietly gathering in all the confederate bank notes he can find. You know the stuff was issued by the ton during the war, and there is any quantity of it still floating around. When the old man gets a big bundle of the paper he sends it to Edison, the inventor, who pays a good price for it. Edison uses it to make carbon for incandescent lamps. The paper upon which the confederate notes were engraved was made of the pulp of sea grass. This branch of the paper-making industry has since become a dead art, says the Philadelphia Record. Sea-grass paper, when chemically treated by Edison, has been found to make the best sort of carbon for incandescent lights, and so there is always a demand for the confederate bills."

An investigation made by Russian experts has resulted in finding, during a period of 109 day, 597 trees that had been recently struck by lightning. Of this number 302 were found to be white poplar, and this notwithstanding the fact that that species is not nearly as common as a dozen other varieties.

That long promised revival of business must be "held up" somewhere en route. One of the most speedy ways of locating its whereabouts would be the issuance of search warrants in the form of attractive and pointed advertisements.

Another underground street railway is being constructed in Washington. It is on the main branch of the Metropolitan road and extends from 36th St. in Georgetown to 15th St. north-east.

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AUTOMATIC PORTABLE BATTERY.

Unique Faradic Machine Capable of Safe and Intelligent Use by Patients.

The Automatic Battery Company, of Louisville, Kentucky, has just perfected and has ready for market a faradic battery that promises to aid the physician very materially in simplifying his work. It is capable of utilization wherever the faradic current is applicable, and the simplicity of its mechanism and of its operation makes its use a very much less serious thing than is the case with the ordinary faradic battery as we know it. No intelligent physician will consent to simply authorize his patient to go and buy a faradic battery and to use it "as per directions enclosed," but he will be more than delighted if he can find a battery that he cannot only use with the patient intelligently and easily, but also teach the patient himself to use it

with equal facility. It would seem that the battery just announced by the Automatic Battery Company is such a piece of apparatus.

The operation of the mechanism consists of the user, that is the patient, taking hold of an ordinary electrode in the left hand, and the handle or main conductor in the right hand, the thumb of the right hand being on the push button at the end of the push rod. The pressure of the thumb upon the push rod will close the circuit gradually, the intensity of the current being increased the further the push rod is introduced. At the end of the push rod is a rack made to engage in the gear, and this engagement, by downward motion, inserts the plunger of the induction coil, thus increasing the strength of the current, and at the same time operating an auxiliary gear, which indicates the strength of current on a dial. Figures upon the dial, arbitrary in themselves, are made to indicate the strength of current used, for the purpose of gauging the particular intensity to be applied in any individual case.

An advantage in this machine over other mechanism is the confidence given to the user by the fact that he can at will increase or decrease the current, and this fact alone secures immunity from that nervousness that we usually find in such cases.

For bath purposes the mechanism is arranged with a second electrode attached to the right of the battery, and its use consists in dropping the electrode usually held in the left hand into the water. After both electrodes are in the water, then the push rod is pressed until the user or the physician is satisfied with the strength of current passing through. The push rod is then locked by dropping the latch into one of the notches provided for that purpose. When through with bath the lock is raised and push rod returns to natural position.

The simplicity of the apparatus is one of its chief advantages. The entire mechanism is securely placed upon an iron frame, which is fastened firmly to the bottom of the case by two machine screws, coming from the bottom upward, andby removing these screws the entire mechanism can be taken out. The battery and circuit breaker are placed securely on the door of the case, the current passing through the hinges of the door. When it is necessary to remove the mechanism from the case the door is simply swung open. All the parts are interchangeable, and the mechanism can be removed or taken apart by any ordinary mechanic.

The faradic battery, and incidentally of course, the battery under discussion, has a very wide field of usefulness in the hands of the intelligent physician. The main feature in the action of induced currents on living organism is the capacity they have for arousing physiological function in nerve, muscle and protoplasm, and in confining their action to those, and not creating changes that are unusual or foreign to the normal tissue activities. Physiological function may depart from the normal standard either in the direction of increase or decrease without becoming strictly pathological, and yet a continuance of this tendency to an unusual degree of it would in time bring about structural changes that would be pathological. Induced, or faradic currents are well adapted to step in at this juncture and either quicken the vital forces to renewed activity, or check them if they are running at an exhausting speed. The faradic current may be used for either general or local effect with great advantage, and the indications for their use would seem to be implied in what has been said above. The point is that a well and easily applied faradic battery that is cheap enough to be within reach not only of the practitioner in moderate circumstances, but his patients as well, will fill a large place in electro-therapeutics of to-day.

Mr. Foree Bain has been selected as engineer to design, purchase and instal an electric light plant for the purpose of lighting the parks and boulevards in the City of Chicago for the West Side Board of Park Commissioners. The plant will consist of one 1,000 horse-power boiler capacity, two 500 horse-power compound condensing Corliss engines, a six-inch jack shaft, with automatic oilers, necessary clutches and pulleys, and eleven 100-arc light dynamos. There will be 1,000 arc lamps of 2,000 candle-power each, installed. The lamps will hang from newly designed park poles. The wire will all be placed underground. There will be required for the plant about 100 miles of underground lead-covered cable No. 5. When finished the plant will be a model. It is Mr. Bain's design to construct the plant with a view to the lowest possible cost of operation. The work of placing the conduits will be begun at once. Apparatus will probably not be required before the first of the year. Mr. Bain is now drawing specifications with a view to submitting them for the purpose of receiving propositions for the apparatus required.

The Fort Wayne Electric Corporation has just issued a handsome catalogue of the "Wood" system of electrical machinery, which everybody interested in light and power transmission will be pleased to possess. A frontispiece shows the extensive works of the corporation, and the publication, in addition to giving a complete description of the machinery and apparatus manufactured, which covers a very full and complete line throughout, is handsomely illustrated with half tone cuts of the different types and sizes which they are prepared to furnish. The catalogue contains 132 pages and is a work of art, in addition to being a compendium of knowledge.

The switching of trains in the yards of the Union depot at St. Louis is done by electricity.

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THE MOTOR VEHICLE CONTEST.

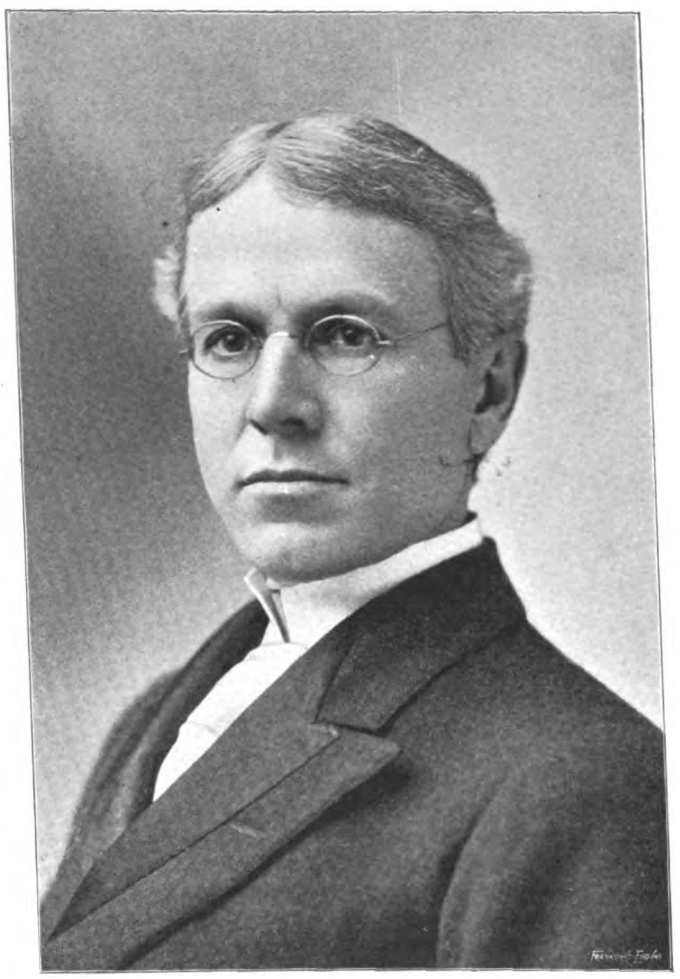
Approaching Times-Herald Race for Horseless Carriages—The Judges—Conditions—Tests to be Made—Course of the Race—Awards.

SUBSTANTIAL RESULTS WILL BE ACHIEVED.

Before THE ELECTRICAL JOURNAL is in the hands of most of its readers, the Motor Carriage Contest inaugurated by the Chicago Times-Herald will be over, and possibly the awards made, but on this later point it is hardly probable that the results will be announced for some days after November 2, the day of the long run.

THE ENTRIES.

There are 63 entries, out of which it seems to be certain that at least twenty-five will participate in the trial, although some of them will not be ready for the preliminary tests on October 29,



H. H. KOHLSAAT,
Proprietor of the Chicago Times-Herald.

30 and 31; and to meet this prospect the judges have determined to make supplementary tests after the November 2 race if necessary.

The entries are as follows:

ARNOLD, B. J., 1541 Marquette Building. Chicago.
AMES, A. C., Owatonna, Minn.
ALLIANCE CARRIAGE CO., Cincinnati, Ohio.
BRADLEY, WHEELER & CO., Kansas City, Mo.
BOOTH, CARLOS B., Youngstown, Ohio.
CONKLIN, OLIVER F., Dayton, Ohio.
CARPENTER, H. H., 1037 Monadnock Building, Chicago.
CROSS, E. D., 3149 Indiana Avenue, Chicago.
CRONHOLM & STENWALL, 319 Le Moyne Street, Chicago.
CLAPP, HENRY W., Sheridan Avenue, Springfield, Mass.
DAVIS GASOLINE ENGINE CO., Waterloo, Iowa.
DALEY, W. H., Charles City, Iowa.
DE FREET THOMAS M., Adjutant General's Office, Indianapolis, Ind.
DURYEA, CHARLES E., Springfield, Mass.
DE LE VERGNE REFRIGERATING MACHINE CO., East 138th St., N.Y.
ELDRICK, GEORGE, 904 Irving Street, Joliet, Ill.
ELSTON, R. W., Racine, Wis.
GAWLEY, T. R,, Aurora, Neb.
GUILFORD, R. W., Auburn, Ind.
HARTLEY POWER SUPPLY CO., 21 Monadnock Building, Chicago.
HERTEL, MAX, 454 Lincoln Avenue, Chicago.
HILL & CUMMINS, 232 South Clinton Street, Chicago.
HALL, JOHN W. & SONS, Jacksonville, Ill.
HAYNES & APPERSON, 23 Buckeye Street, Kokomo, Ind.
HAGAMAN, J. D., 52 Riverside Avenue, Adrian, Mich.
HOLMES, LYMAN S., Gloversville, N. Y.
HOLTON, MILTON E., 375 Dayton Street, Chicago.
KAPPE, W. J. H., Quincy, Ill.
LEWIS, GEORGE W., 32 Willis Court, Chicago.
LASHER, R. E., 2722 South Third Street, St. Louis, Mo.
LEPPO BROTHERS, Belleville, Ohio.
McDONALD & BRENNAN, Kedzie Avenue and Thirty-fifth St., Chicago.
MOEHN, J. N., 1810 Fond du Lac Avenue, Milwaukee, Wis.
MILLS, M. B., 125 LaSalle Street, Chicago.
McARTHUR, A. W., Rockford, Ill.
MERDITH, EDWIN, Batavia, Ill.
MORRIS & SALVIN, 926 Drexel Building, Philadelphia.
MUELLER, H., Decatur, Ill.
MILLS & SEARLS, Chicago.
MAGUIN POWER GENERATING CO., 709 Masonic Temple, Chicago.
OKEY, PERRY, Columbus, Ohio.
PIERCE ENGINE CO., Racine, Wis.
PATERSON, WILLIAM, 302 South Morgan Street, Chicago.
ROBERTS, S. W., 80 Dearborn Street, Chicago.
RIEL IMPORT CO., 51 Dearborn Street, Chicago.
ROBERTSON, G. W., Mount Vernon, Ind.
SMITH, OTIS E., Hartford, Conn.
SHAVER, JOSEPH, Walnut and Nineteenth streets, Milwaukee.
STURGES ELECTRIC MOTOCYCLE CO., 1137 Marquette Bldg., Chicago.
SCHOENING, C. J. & J. W., Oak Park, Ill.
SINTZ GAS ENGINE CO., Grand Rapids, Mich.
STRONG & GIBBONS, 181 West Madison Street, Chicago.
STONE & MAYNARD, 438 West Twenty-ninth Street, New York.
SIMMONS, W. A., 6642 Wabash Avenue, Chicago.
TEMPLETON, JOHN, 1616 Masonic Temple, Chicago.
THOMAS KANE CO. (Pennington Motor), Chicago and Racine, Wis.
TAYLOR, ELWOOD E., Fitchburg, Mass.
THE TINKHAM CYCLE CO., 825 Monadnock Building, Chicago.
VERRETT, N. J., 313 Cherry Street, Pine Bluff, Ark.
WAYNE SULKEYETTE AND ROAD CART CO., Decatur, Ill.
WILKINS, VERNON H., 2249 Ridge Avenue, Evanston, Ill.
WILSON, DAVID H., 901 Association Building, Chicago.
WOLVERINE MOTOR WORKS, 12 Huron Street, Grand Rapids, Mich.

THE JUDGES.

Mr. Kohlsaat, publisher of the Times-Herald, has been anxious, from the first, that the contest should avoid, as far as possible, the spectacular and sensational, and that it should be fruitful of lasting, substantial results. Before appointing his judges, therefore, he impressed upon each his own views in the matter, and made the appointments after satisfying himself of their coincidence with him on these points. The judges selected are Major-General Wesley Merritt, U. S. A., Commanding the Department of the Missouri; Mr. John P. Barrett, City Electrician of Chicago, late Chief of Department of Electricity of the Columbian Exposition, President of the National School of Electricity and THE ELECTRICAL JOURNAL; Mr. Henry Timpken, of St. Louis, President of the National Carriage Builders' Association. These gentlemen immediately named their assistants respectively as follows: Col. M. I. Luddington, U. S. A., Mr. L. L. Summers and Mr. Charles F. Kimball. General Merritt was selected as the presiding officer of the board, and Mr. J. Allan Hornsby, of the National School of Electricity, Managing Editor of THE ELECTRICAL JOURNAL and late Assistant Chief of the Department of Electricity of the Columbian Exposition, as secretary.

RULES OF THE CONTEST.

The first work of the board of judges, after organization, was the formulation of the general rules for the contest. The rules follow:

ARTICLE I.

The contest or race will be international in character and any vehicle complying with the conditions may compete.

The vehicles shall have three or more running wheels and shall derive their motive power from within themselves. No vehicle will be admitted to

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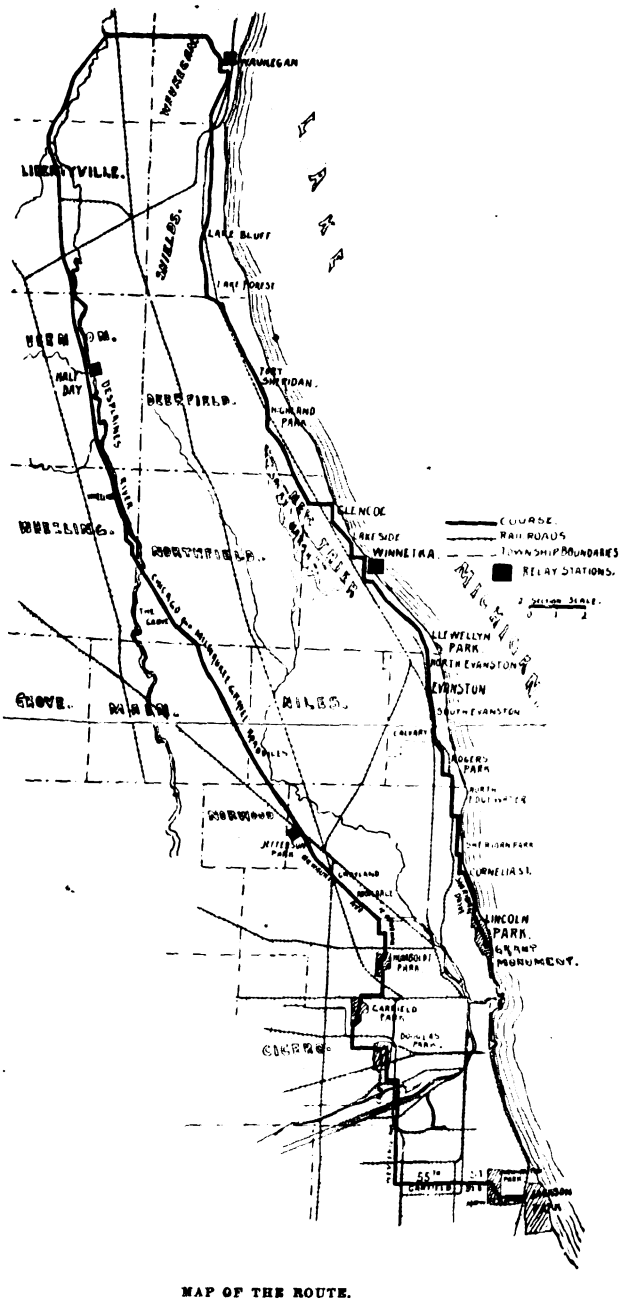
the competition which depends in any way upon muscular exertion except for the purpose of guidance.

ARTICLE II.

The vehicles shall be capable of carrying at least two persons, one of whom shall be an umpire selected by the judges, and the other or others may be the representatives of the owner of the vehicle. An umpire must accompany each vehicle over the route.

ARTICLE III.

The route will be from the Midway Plaisance, Chicago, via Jefferson Park and Half Day to Waukegan, and from Waukegan south through Winnetka to Lincoln Park, following the official course outlined in detail by maps which will be furnished to each contestant. Jefferson Park, Half Day, Waukegan and Winnetka are relay places at which motive power may be replenished.



MAP OF THE ROUTE.

ARTICLE IV.

There will be stationed at each relay point a timekeeper, who will report the time of arrival and departure, but stoppage at relay stations will be optional with contestants, and no allowance will be made for delays in replenishing.

ARTICLE V.

It is expected that each contestant will make his own arrangements for replenishing motive power or taking advantage of the relay facilities.

The umpires will be furnished with a correct statement of supplies furnished at the starting point, at each relay point, and where possible of the amounts remaining after completion of course.

ARTICLE VI.

Vehicles will assemble at the junction of the Midway Plaisance and Jackson Park at 7:30 a. m. Nov. 2, 1895, and take such positions as may be assigned them by the judges.

ARTICLE VII.

Each vehicle entered shall carry a card conspicuously displayed, this consisting of a white card 12 inches square provided with a black letter 6 inches long. Each contestant shall be designated by number. The numbers and order of starting shall be designated by the judges.

ARTICLE VIII.

The starting point will be the Midway Plaisance and Jackson Park, from which point the vehicles will proceed through Washington Park and the route outlined, to the corner of Halsted street and Garfield boulevard. Up to this point the carriages will move along without attempting to pass each other, maintaining the order in which they started and endeavoring as nearly as possible to keep the same distance apart as at the time of starting. No trial of speed will be permitted between the limits of the park and Halsted street. At this latter point they will halt and be started by signal from the judges.

ARTICLE IX.

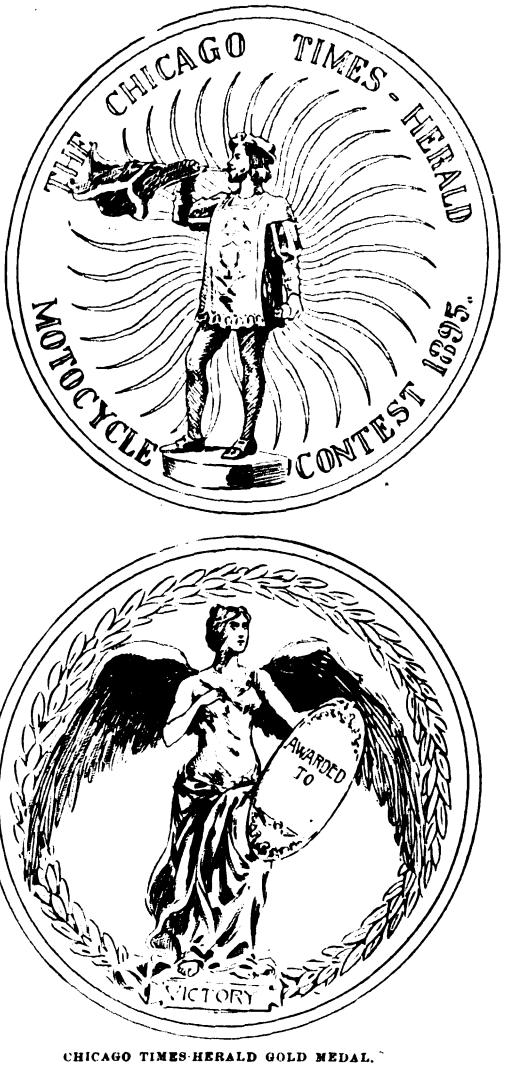
Contestants may change conductors at such points as they may desire. The umpire appointed by the judges will remain with the vehicle until it finishes the contest, either by completion of the course or by withdrawal.

ARTICLE X.

Each vehicle shall be provided with three lights. These should be of any of the standard carriage or bicycle pattern; two lights shall be placed in front of the vehicle and one red light in the rear. These lamps shall be lighted not latter than 5 p. m.

ARTICLE XI.

Each vehicle shall be provided with a trumpet, foghorn or other signal capable of sounding a warning signal of approach.



CHICAGO TIMES-HERALD GOLD MEDAL.

ARTICLE XII.

When two vehicles going in the same direction and at different rates of speed find themselves in proximity the slower one must keep to the right and leave half of the road available. Any vehicle attempting to prevent by maneuver the passage of any other vehicle will be disqualified. The umpire on the vehicle will be expected to enforce this condition.

ARTICLE XIII.

The ordinary rules of the road must be observed by all vehicles, and in meeting ordinary vehicles it is expected that care will be exercised to insure proper safety to the ordinary transients.

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ARTICLE XIV.

Any civil or penal responsibilities must rest entirely with the contestants who incur them. The judges, umpires or referees assume no responsibility of any nature whatever.

ARTICLE XV.

If several vehicles arrive together, or successively in front of an obstacle which necessitates the stoppage of the first vehicle, the other vehicles must stop in their order without attempting to pass each other until a distance beyond the obstacle of one hundred yards has been covered.

ARTICLE XVI.

The umpire of the first vehicle to reach the obstacle shall have the ruling power.

ARTICLE XVII.

The umpire of each vehicle will take the time of arrival at an obstruction and the time of its removal. This time shall be reported to the judges.

H. MUELLER'S MOTOCYCLE.

ARTICLE XVIII.

In no case may two vehicles move along abreast of each other in a trial of speed. A vehicle wishing to maintain its position must do so before proximity necessitates the surrender of right of way as per article XII.

ARTICLE XIX.

The awards will be made upon the condition of—first, utility, adaptability, excellence of design, cost and economy of operation. Second, speed.

ARTICLE XX.

No vehicle will be admitted to the competition unless the safety of occupants, spectators and users of the public highways will be insured.

ARTICLE XXI.

The judges reserve the right at their discretion to debar any vehicle which may contain elements either of danger or from its construction an evidence of weakness or general impracticability.

THE JOHN W. HALL & SONS MOTOCYCLE.

ARTICLE XXII.

For the purpose of debarring any vehicle which may in the opinion of the judges contain elements sufficient for its rejection, preliminary trials will be held on October 28, 29, 30. All contestants must present their vehicles for examination in test as specified.

ARTICLE XXIII.

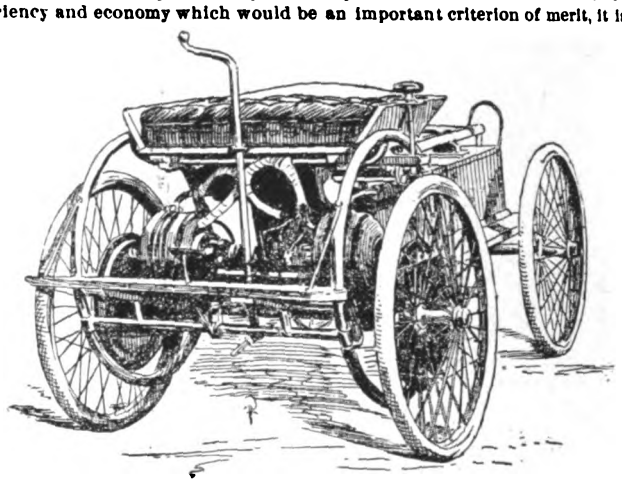
A detailed examination of the vehicle and its mechanism will be made by the judges and such experts as they may select. Tests will be made to determine the economy, efficiency, etc., of the vehicles, and it is expected that owners of the vehicles will offer every facility to the judges for this purpose.

ARTICLE XXIV.

Any vehicle which has taken part in the recent competition held abroad will be allowed to compete in the contest, provided, however, that it shall be optional with the judges as to whether detailed tests upon these vehicles are to be made.

ARTICLE XXV.

Inasmuch as the preliminary trials may not involve the detailed tests of efficiency and economy which would be an important criterion of merit, it is



THE MORRIS & SALOM ELECTROBAT.

understood that any vehicle which shall compete in the contest shall be placed at the disposal of the judges for subsequent tests should they desire it.

ARTICLE XXVI.

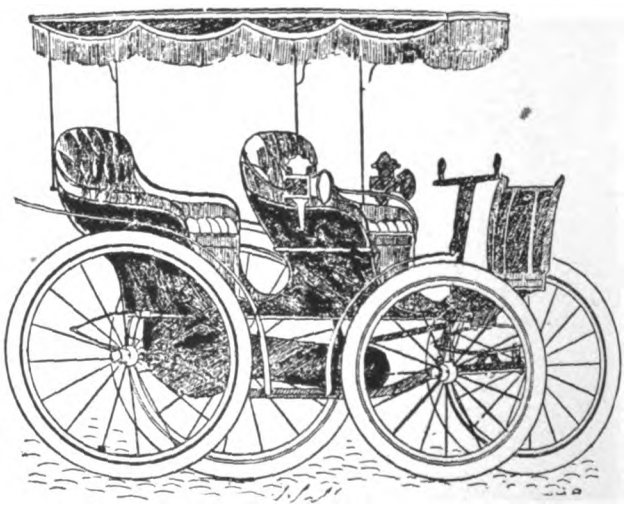
The subsequent tests of vehicles may be over such route and at such times as the judges may designate.

ARTICLE XXVII.

Every effort has been made by the judges to determine the route, and direction posts have been placed to aid the conductors of vehicles. The conductor of the vehicle will be responsible for not following the route, and no claims will be allowed on account of delays or inconvenience experienced on account of mistaking the route. Conductors will be expected to familiarize themselves in advance and thus avoid any trouble from these causes.

ARTICLE XXVIII.

A time limit of thirteen hours will be set. Any vehicle failing to cover the route in thirteen hours, corrected time, will be disqualified. In computing the corrected time from the time of starting and of finishing, the reports of the umpires will be taken as to legitimate delays experienced upon the route.



HILL & CUMMIN'S MOTOCYCLE.

ARTICLE XXIX.

Unavoidable obstacles, such as railroad trains at road crossings and other unusual obstructions in the roads, will constitute the only grounds for an allowance of time by the judges.

ARTICLE XXX.

Delays, experienced from imperfection of mechanism, break-downs, difficulties in starting, or similar causes, will not constitute grounds for time allowances.

ARTICLE XXXI.

Any repairs which may be required along the road must be executed by the occupants of the vehicle. Outside assistance will not be allowed, the umpires excepted.

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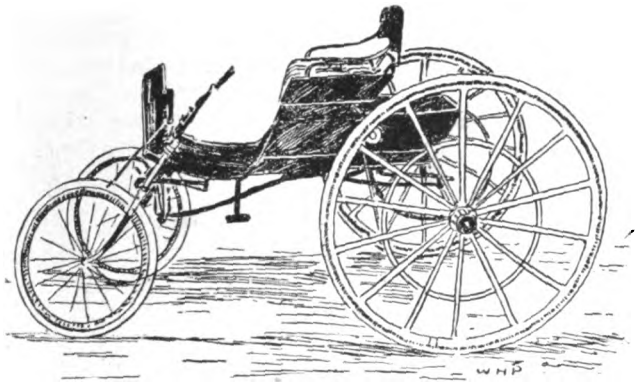
ARTICLE XXXII.

Any infraction of these rules may disqualify a vehicle at the option of the judges. The judges also reserve the right to modify or amend these rules.

ORDER OF THE CONTEST..

Preliminary trials for contestants will be given at the Washington Park race track on three days preceding the final or long run, the trials to be on October 29, 30 and 31. A platform will be constructed with jacks, pulleys and weights, with dyna-



THE CARPENTER ELECTRIC MOTOCYCLE.

mometer attachments for measuring precisely the pulling capacity of vehicles under load. The wheels will be braked, the fuel or motive power measured, and each vehicle given a three-hour run.

Succeeding these exhaustive tests the *race* will take place.

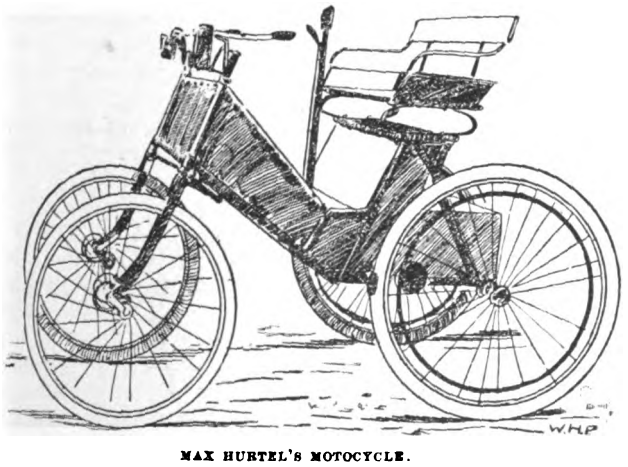
THE LONG RACE.

The course will be from Midway Plaisance and Halsted street, in the southern district of Chicago, through Jefferson Park and Half Day to Wankegan, and returning by way of Winnetka and the lake shore to Lincoln Park, Chicago.

Each contesting vehicle will be accompanied by an umpire, who will act under the following rules, and who will fill out the blank form accompanying:

INSTRUCTIONS TO UMPIRES.

Umpires will be assigned to vehicles by the judges, and no umpire shall serve who is in any way interested with any of the contestants.



MAX HURTEL'S MOTOCYCLE.

The umpire will join his vehicle at 7.30 A. M., November 2, 1895, at the junction of Midway Plaisance and Jackson Park.

The umpire will remain with his vehicle continuously until the terminus at Lincoln Park has been reached, or until the vehicle has been definitely withdrawn from the contest.

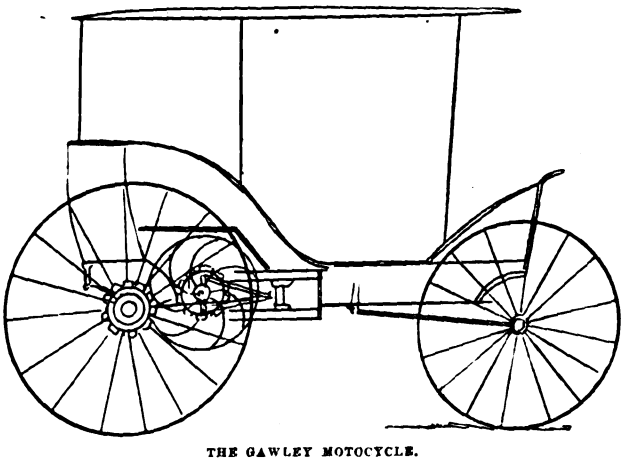
In the event of an accident the umpire will see that no outside assistance is given in moving or repairing the vehicle, but at his discretion he may aid the conductor or operator in making any needful repairs, or to pass any obstruction or bad part of the road.

The umpire will carefully and accurately fill out the blank form furnished him by the judges, and will also make a full and detailed report of the occurences and incidents of the journey.

Umpires will familiarize themselves with the rules of the contest, and will see that they are observed to the letter. Copies of the rules will be furnished for the purpose.

REPORT BLANK.

Name of contestant .....
Quality and exact amount of motive power at start.....
Time of start—hour, minute and second .....
Time of arrival at and departure from each relay station—Jefferson Park.....
Half Day..... ..... Waukegan .....Winnetka.....
Quality and amount of motive power taken at each relay station—
Jackson Park..... ....Half Day.....
Waukegan..... ....Winnetka.....
Time of arrival at terminus .....
Full report of occurances enroute.....



THE GAWLEY MOTOCYCLE.

AWARDS.

The judges will have arbitrary and absolute voice in passing upon the merits of vehicles and in awarding the prizes. To this end they have made the order of merit as follows:

1. General utility and adaptability.
2. Ease of control.
3. Speed.
4. Cost.
5. Economy of operation.
6. General appearance and excellence of design.

THE PRIZES.

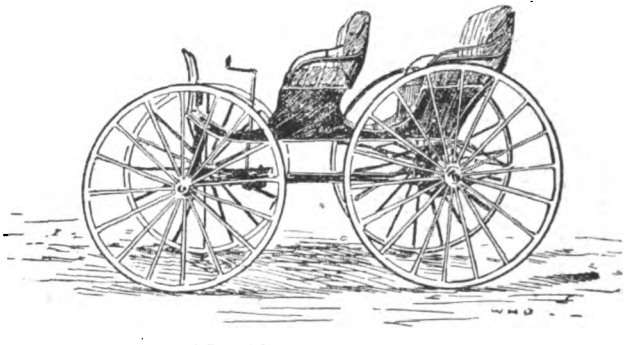
The first prize will be $2,000 in cash and a gold medal, the competition being open to the world.

The second prize is $1,500, with the stipulation that in the event the first prize is awarded to a vehicle of foreign invention or manufacture, this prize shall go to the most successful American competitor.

The third prize is $1,000.

The fourth prize, $500.

The third and fourth prizes are open to all competitors, foreign and American.



THE ELSTON GASOLINE MOTOCYCLE.

METHODS OF TESTING.

The board of judges have appointed Messrs. Barrett, Summers and Hornsby as an engineering committee to make the tests, and submit an engineering report.

The method adopted of testing for the preliminary trials by the judges, consists of a raised platform with an incline leading to it, permitting the motocycle to be run upon the platform without difficulty. Immediately in the rear of the platform is a

[*Continued on page* 221.]

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THE ELECTRICAL JOURNAL

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(1st and 15th of each Month)

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

VOL. I. CHICAGO, NOVEMBER 1, 1895. NO. 11.

Danger With Alternating Circuits.

The recent very sad accident which caused the death of Mr. F. L. Pope, calls attention anew to the great danger attending the handling of alternating circuits. It is therefore important that the public should be advised of certain reasons for this danger which have not, so far as the writer is aware, been publicly alluded to. The danger lies not alone in the fact that high voltage is used, nor that grounds are likely to exist, particularly, in wet weather, but there is an additional source of trouble of prime importance in some cases. To be forewarned is to be forearmed; I therefore venture to draw special attention to this newer feature of alternating current working.

It should not be understood that there is any new cause of alarm, or that alternating currents are too dangerous to be used by the public; the truth is that high potential circuits are always dangerous, and the sooner the public are convinced of that fact the better. Too much nonsense has been written about the difficulty of killing with electricity without the surgeon's knife. The circumstances under which a shock is received may be very different in different cases; and one man may be killed with a comparatively low voltage, while another survives a shock from a much higher one. The only thing proved in such cases is that even the lower voltage, with enough energy behind it, is sufficient to kill. It is quite possible to have so much regard for electricity that one may be lead unconsciously to minimize the danger to human life.

The particular danger which is now emphasized arises from the *capacity* of the circuit. Even with perfect insulation of a 1,000-volt circuit, it may not be safe to ground it anywhere through the person. I have in mind now a 1,000-volt alternating plant, which was installed with as great care and forsight as the present state of the art permits; the insulation resistance is unusually high, and this circuit operates admirably in every way. But if a series of five 100-volt lamps is connected between the ground and the line, the five lamps will light up with nearly full candle power. The explanation is that the line is in part a cable running through a conduit, and it has sufficient capacity to produce this effect. It is very evident that it would not be a healthful experiment to ground this line through the body.

For a capacity in series, with negligible resistance between the capacity and the source, it is well known that the value of the current (square root of mean square) that flows into the condenser and out again is the product of the capacity in farads, the electromotive force in volts, and the angular velocity, or 2π times the number of complete periods per second. If, for example, the capacity should be one microfarad, the voltage 1,000, and the frequency 100, then the current would be approximately six-tenths of an ampere. On a 1,000-volt circuit the electromotive force would in general be only about 500 volts between the line and the ground. Even when the capacity is distributed, there is danger enough in such a circuit if the capacity is very appreciable.

It is not intended to suggest here that this cause of danger had anything to do with the death of Mr. Pope. The known leaks on the line in that case were sufficient to account for the accident.

Henry S. Barrett

* * *

What Will Come of It?

The pace-making trials which have been occuring for some months past on American and English steam railroads have developed some striking bursts of speed by the steam locomotive. The latest feat is so remarkable that it can be met with only admiration at the results accomplished and the means of their accomplishment. A run from Chicago to New York (not far from one thousand miles) at an average speed of little less than sixty-five miles per hour will doubtless be exceeded in the future, but the full proof of its practibility makes a striking reference point in the improvement of railway speeds over long distance runs.

Such runs as the late one over the Lake Shore and New York Central railways, tax roadbed, rolling stock, and the discipline of personel toward the limit of their endurance, but by means of similar experiments speeds in long distance travel have been reached which could not have been foreseen a few years ago by the staunchest advocate of the steam locomotive, and the limit is not yet reached. The commercial limit for this country must come soon, for there are few roads which afford for one-half the distance an equal ease in grade and alignment as that of the combined lines of the Lake Shore and New York Central roads. The limit of speed for trains operated exclusively by the steam locomotive will therefore probably be set by the conditions met on the less fortunately located trunk railroads. This limit reached, will we pause while the great progress in railway speeds, which has been making for the past five years, lapses into a burst of improvement, followed, as is often the case, by a period of comparative quiescence, during which further great improvements are not attempted? It is a bold man who may prophesy in this, but in the light of the developments of a few years past we may well be expectant. Much further progress in cutting down the time of the trip between New York and Chicago must be brought about by the competitive efforts of railroads less favorably situated with respect to grades and curves than is the Lake Shore and New York Central line. The handicap of grades and curves requires much greater bursts of maximum speed to gain an equal average. These speeds must finally run even beyond the marvelous endurance of the steam locomotive, unless radical improvements, which are not now in evidence, can be made, and the uniform torque of the electric motor may yet to prove to be a necessity in heavy fast express service. The trolley system does not seem to lend itself to this service, and it would be startling to find the Pennsylvania Railroad forced at no greatly distant date to use the principle of the rather cumberson Heilmann locomotive in the operation of its fastest express trains; it being forced to do so in order to compete with the speeds of the steam locomotive on its more favorably situated neighbor.

D. G. Jackson

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The Motor Vehicle Contest.

Since our last publication, the Chicago Times-Herald horseless carriage contest has become the leading topic of news in scientific circles, and there is no reason to believe that the people generally will be disappointed in their hope that the contest will demonstrate the actual conditions under which various forms of motors can be made to supply the place of man's friend, the horse, in the more active business and pleasure of moving about.

For a long time motor carriages have been scientifically possible but not commercially available because of their cost and unwieldiness—not to speak of their dangers. Competition, of whatever nature, could command little of the popular interest unless there were an element of usefulness at the basis for it, and so with these locomotives. Did not the people believe that their common use was in the perspective, little interest would be manifested; and likewise the mercantile world would not be anxious to spend its dollars in rivalry. So we may fairly assume that first—there is a common demand for something that motor vehicles promise to meet; second, that there is strong popular conviction that the time is come for a realization of the popular wish; third, that experts who ought to know the real conditions, share this belief since they are anxious to spend their money to show—what, a scientific truth? Not at all, but commercial possibilities.

The French tests of motor vehicles have not been productive of deciding any definite results. They have had some long *races*, over varied and at times exacting roads, and the prizes—at least the principal one, was given to a petroleum motor, and so far as we at a distance can learn, on the score of speed alone—at any rate the fastest machine got the prize, and speed occupied the first place in the score of the judges. But nothing was proven that has any meaning, or that serves any good purpose.

Much more is promised from the approaching contest. Speed occupies a very small place in the score card, general utility being set at the head with large figures to represent perfection. Other important items of merit are cost, cost of operation and facility of control.

Not alone is it intended to have a test of speed, endurance, strength and economy in a run of one hundred miles over all sorts of road, but preliminary and supplementary tests are to be given that will, or should bring large results in deciding the paramount questions upon which hinge the acceptance of the "horseless carriage" as the vehicle of the future.

The tests that have been decided upon by the judges will be made under prepared and ideal conditions. Machinery has been erected at Washington Park race track, Chicago, that will permit each vehicle to be given a test of capacity, taking into consideration quantity and cost of fuel, or motive power, and all other conditions that are of consequence to the judges, so that after the judges have summed up their findings, it will be possible to say just what each vehicle can, and will do commercially—its cost of operation in fuel or power and in dollars and cents, its carrying capacity under any given conditions, its safety, its durability, so that the prospective purchaser may have all necessary figures to guide him in his purchase of a vehicle for any given purpose.

* * *

London's Telephone Service.

The old adage that "murder will out" seems to be verifying itself without any help anent the telephone service of London, which Mr. Preece, the superintendent says is the best in the world. The London Electrical Engineer—good authority in itself—quotes the following from the London Financial Times:

In order to give the telephone a fair trial we made an impromptu experiment last night from the offices at which this journal is printed, two members of our staff joining in the trial, having separate receivers attached to the same instrument, and adhering rigidly to the printed rules. In the first instance, after listening for a reply from the exchange, and getting it, we were asked for the number of the subscriber wanted, and gave that of our City telephone. Nothing happened for some little time, and then the operator remarked, "Well?" It turned out that she had not heard the reply. Finally, communication was established *in the strictly limited sense of the London telephone*—that is to say, it was clear to the subscriber at each end of the wire that somebody was talking to him from the other end. But intelligible conversation was found impossible, even to the extent of explaining the object of the call. While efforts to this end were in progress, our representatives learned with intense interest that somebody unknown was "wanted at the Adelphi," together with a quantity of other information which was only relevant to the object of the call in that it emphasized one of the most glaring defects of the system. Next we tried Brighton, and asked for the Metropole Hotel there. The reply came promptly that we could not be put through, and our natural rejoiner was, "Why?" The operator promised to enquire, thereby breaking one of these precious rules, which says "that the operators are strictly forbidden to answer any question." We should feel very thankful if conversation between subscribers were as clearly audible as was the altercation which ensued between the operator who had said we could not get through and the one who had conveyed us the message. Ultimately we were told it was a mistake arising from an idea that our printing works were a hotel. Why that should have prevented our talking to another hotel we knew not; but such was the explanation given. After a little more delay, we were asked if we knew that there would be a charge of a shilling; and having satisfied the exchange that we were willing to risk that sum, the desired communication was effected. From Brighton every word was audible, in spite of the conversation which was going on at the same time on the London wires as to a place of amusement for the evening. This experiment was quite unpremeditated. Our representatives did their best in every way to give the telephone and its operators a fair chance. The results as above stated are in no way exaggerated, nor are they an exceptional experience. Surely there must be some remedy for this sort of thing.

Any comment on this London expert opinion of the London telephone, would of necessity be worse than weak. But we would be glad to quote Mr. Preece in reply to the article—provided, of course, that expletives are barred.

* * *

Firemen and the Trolley.

It has been repeatedly predicted that the day—or the night—would come when there would be a conflict between the fire department and the over-head trolley lines. Within the last week the tussle came. There is nothing so convincing as an object lesson, and the display of pyrotechnics at a fire in Chicago on October 22 last should have much food for thought for that portion of the community which has been so anxious for, and so laudatory of, the overhead wires now being strung everywhere throughout the city.

It begins to look as if it would be better not to have had the streets cleared of wires—as if the driving out of the conductors of the telegraph and telephone companies was ill-advised—that they even, as great a nuisance as they were becoming, had better have remained, and the excuse would not then have been available that "the streets are clear of wires, and there can be no harm in letting us railroad people occupy that vacant space."

The firemen complain, and very justly, too, of the dangers that threaten them in fighting a fire where wires carrying a trolley current may become deranged, crossed with normally innocent lines hanging loose above and around them. There is no danger signal shown by a live wire until it contacts with something, and it isn't at all particular whether it is a tin pipe, or a water nozzle, a man or a tobacco-sign. Electricity has been so recently brought into society that its education is not yet complete enough to know these little differences, and, up to date, it resembles the rain, in that it falls alike on the just and the unjust.

A sturdy, persistent fight was kept up for several years by the head of the Chicago electrical department to force all these, as well as less dangerous wires underground. There seemed to be a moral fear on the part of a class of business men, who should have flocked to the ranks of the standard-bearer, that such action on their part would imperil their profits, and make them unpopular with their clients; and they seemed to hope by standing in the shade that the fight would be won without their aid. Then, when the "cruel war" was over, the spoils and emoluments would be theirs, and the blood and treasure wasted would not have depleted their treasury nor undermined their constitutions.

The trolley is here now, and has probably come to stay. In the language of the great naval commander, slightly changed, "We have met the enemy and we are theirs."

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A negro fell from an electric light pole in Louisville a few days ago and was instantly killed. An account of the accident says it has not been satisfactorily established whether the man was electrocuted, or whether he died from a fractured skull as the result of the fall. No one will, of course, believe that a negro's skull was ever cracked by so trivial an affair as falling on his head from such a distance, and hence electricity will do as it has often had to do before, bear the responsibility for results that cannot be satisfactorily accounted for by any other hypothesis.

There are some things that people may have "without money and without price," but the delegates from New York to the Montreal Street Railway Convention would not have had nearly so good a time without Price as they had with him, and they showed their appreciation of his able efforts as master of ceremonies by presenting him with a handsome testimonial made of sealskin, lined with cream satin, the pages within bearing the resolutions handsomely engrossed. Mr. Price is a genial, good fellow, and the testimonial, we venture to say, was fully merited.

Our Canadian friends should know that it is not alone an Englishman whose heart is reached through his stomach. Americans evidently are built upon the same plan, for our esteemed contemporary The Electrical Engineer, in speaking of the annual banquet given to the American Street Railway Association in Montreal, has been moved to remark that "the dinner given at the Windsor was in the Windsor's worst style, and was a very tame and wearisome affair." Perhaps there was a scarcity of pie.

The congratulations extended to each other by the members of the American Street Railway Association when the floating indebtedness was cleared by subscriptions, reminds us of the man who, when called upon by a creditor for a settlement of his account, filled out a note for the amount, and as he handed it over said, "Thank God that account is paid." Perhaps it is safe to assume, however, that in case of the Association a promise to pay is as good as gold.

The selection of judges by Editor Köhlsaat for his motocycle contest shows the discerning and far-seeing character of the man. General Merritt was selected doubtless to see that a proper share of "general merit" was accorded to the several contestants, while Mr. Barrett was probably appointed so that in the event of any entry being made which might conflict with the rules governing the race, he would be there to "bar it" out.

It is good business management that knows when and how to "throw a sprat to catch a mackerel," and the Brooklyn Heights Railroad Company in offering $10,000, to be distributed among those of its employes who avoid accidents either to the property of the company or to the public, gives evidence that its affairs are being governed by a far-seeing and judicious management.

"Necessity is the mother of invention," says the old adage, and recent events would tend to the belief that $5,000 in prizes is the godmother, at least so far as it applies to motocycles.

Niagara had better look after her laurels. Lockport, Ill., and the great drainage canal are conspiring to rob her of her glory as a water-power for the generation of electric current.

Joel Hurt is so accustomed to chasing the seductive nickel that it is not to be wondered at that at the chase at the Montreal fox hunt he succeeded in capturing the mask.

The old saying that the race is not always to the swift, will be exemplified in the motocycle contest in Chicago, speed being third in the list of points of excellence.

A street railway convention without the presence of the festive supply-man would be like the play of Romeo and Juliet with the balcony scene left out.

The mule may naturally be expected to register a kick about the introduction of electricity for towing boats on the Erie Canal.

ELECTRICITY AT A DISADVANTAGE.

Cannot Compete With Other Forms of Motive Power for Road Vehicles.

Since the advent of the electric car the inquiry has been frequently made why electricity has not been applied to the propulsion of ordinary vehicles as a substitute for the horse. Such a carriage was exhibited at the Columbian Fair, and was driven around the roadways in Jackson Park. Small boats were also propelled through the water ways. Tricycles too have been provided with electrical power, and all of them are most easily managed in starting, stopping, speed and directing. Why then have they not come into general use?

A carriage, in order to be of much use, needs to have its supply of energy along with it. The trolley can get its motive power from the wire which reaches to the power-house, and is as helpless as a wheelbarrow when disconnected from that. To supply the carriage with adequate power, galvanic batteries, both primary and secondary, have been often tried. The best primary battery now known rapidly fails in efficiency and needs to have its liquids renewed after each use of a few hours, a condition which excludes it from any service of this kind. Secondary batteries are not subject to the same difficulty, but they have others as serious which have incapacitated them for such service.

To propel an ordinary carriage over an ordinary road a single horse is efficient enough, for if hills are met or poor roadways, he can be called upon to work hard at a slow pace. Such a horse may work for a short time at the rate of two horse power or more. If by pulling five hundred pounds the carriage be moved only two feet in a second, the horse has spent nearly two-horse power as reckoned with engines, and a similar expenditure will be needed of any substitute, so not less than two electric horse-power will be needed for an emergency in a carriage which can ordinarily be driven with one horse power.

Electric energy is made up of two factors, voltage and current. Their product is called watts, and 746 equal a horse-power. A single cell having two volts pressure, as do most of secondary cells, would need to furnish a current of $\frac{746}{2} = 373$ amperes for a single horse-power. It is found that a good cell, weighing about forty pounds, will furnish 100 ampere hours of current, ten amperes for ten hours, twenty amperes for five hours, and so on. Nineteen such cells would be needed to furnish one electrical horse-power for five hours, and together they would weigh 760 pounds, almost as much as a good horse. If the battery were wanted for ten hours work it would need to be twice as heavy, for the staying power of such cells is proportionate to their weight.

These considerations show that an electrical carriage run by secondary cells must be made capacious and strong, and will be well loaded without occupants. This, too, presumes that the motor used is a theoretically perfect one, which will transform all the electrical energy into mechanical. No motor can do that, and it is a very good one that yields 75 per cent. This would make it needful to increase the number of cells by one-fourth, and if two horse-power is needed for an emergency, twice the full number, or about 50 cells must be provided, altogether weighing a ton, aside from the carriage itself.

Again such cells need to be charged, a process which takes several hours at a time, and each cell needs to be carefully tested in several ways, for there are several distempers to which they are subject, and an expert is needed constantly. These are the reasons why electric carriages have not been seen on the roads, and why they are not likely soon to be.

The new naphtha and petroleum engines seem now to have that whole field to themselves, for such engines, weighing but two hundred pounds, can be made to give three or four horse-power and run a hundred miles on a common road at a cost of but a dollar or so.

A. E. DOLBEAR.

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PATENT OFFICE RULING ENFORCED.

Since my publication of information about the new time limit, in the daily papers and engineering periodicals, some inventors have called upon me and alleged that their attorneys advised them that I was wrong, and that the new rule was reversed. Those who paid no attention to the new rule are now receiving the following notice from the Patent Office.

"Under present rule 65, this application has been re-examined. The claims are again and finally rejected on the references of record."

This means that the same claims can be further prosecuted only by appeal; whereas, if they had been acted upon by the attorney within six months after the first rejection, an argument could have been filed in behalf of patentability of the invention, without depositing the fee for appeal.

In brief, the new rule requires action by the attorney within six months after any decision of the United States Patent Office, instead of two years, as formerly. The rule went into effect on April 15, 1895, and affected pending cases as rejected on that date, and therefore the first limiting date was October 15.

EDWARD P. THOMPSON.

New York City, October 22, 1895.

"UPON WHAT MEAT DOTH THIS OUR CÆSAR FEED THAT HE IS GROWN SO GREAT."

ICICLE BILL—Wretch! I am out of patience with you! Did I not commission you to decapitate the Chief of the Electrical Department of Chicago?

EDITOR JOHN—By day and by night, noble master, have I labored to that end.

ICICLE BILL—Labored! Bah! You remind me, John, of the mountain that labored and brought forth a mouse. 'Tis results I want! Do you hear me?

EDITOR JOHN—But, noble master, he laughs me to scorn and makes light of my most earnest endeavors. Have I not furnished Bro. Medill with statistics contrasting the cost of electric lighting in Podunk and Chicago, and said not a word about the difference in candle power, the number of hours of service provided, or any of the other extenuating circumstances?

ICICLE BILL—Umph! Then is our case hopeless! For, if I remember aright, Disraeli once said "there are three forms of misleading the people; by lies, by damn lies, and by statistics." Having resorted to all these and failed, then indeed are we lost.

ICICLE BILL—But that "Electrical Journal," John; Is that dead yet?

EDITOR JOHN—Not yet, noble master. There have I also labored by day and in my dreams by night, and yet—

ICICLE BILL—And yet, what? Have I not oft repeated that there is room in this town for no other electrical paper than mine?

EDITOR JOHN—Alas, 'tis true! Woe is me, my master! But once again will I gird me about to do battle for the cause—and thee.

ICICLE BILL—Get thee hence John! get thee hence! and bring me when next thou comest, "The Electrical Journal" on a charger, (aside) and I will read it to get the news.

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THE SCIENCE OF PHOTOMETRY.*

Description of the Lummer and Brodhun and Weber Portable Photometers—The Latter Well Adapted for Testing of Arc Lights.

DIAGRAMS OF THE DIFFERENT INSTRUMENTS.

Among the many forms of photometers designed for the purpose of securing greater accuracy than that afforded by the Bunsen screen, the most successful is the screen of Messrs. Lummer and Brodhun. It is represented with its top plate removed in Fig. 1. The instrument owes its excellence to the effects produced by a pair of prisms, marked *A* and *B*, Fig. 1. Fig. 2 represents a section through the prisms. They each have two plane surfaces, forming ninety degree angles at *A* and *B*. On the spherical surface of each a small flat surface is ground and highly polished, the flat surface on *B* being about three times as wide as that on *A*. These surfaces, which are equally inclined to the outer flat surfaces, are placed in contact and firmly pressed together by the clamp *q* (Fig. 1), so as to exclude air. If rays of light, 1, 2, 3, enter prism *B* (Fig. 2) from the right, rays

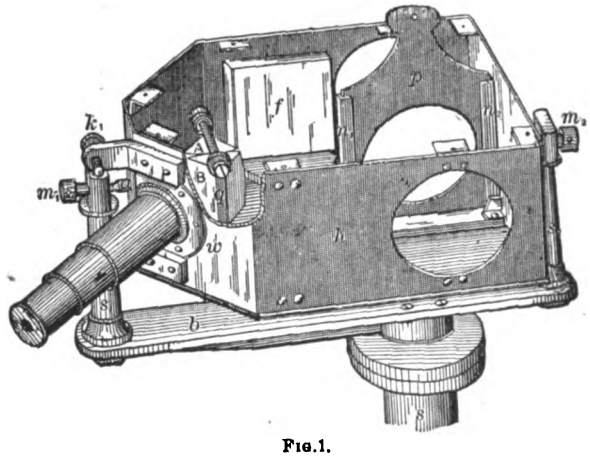

Fig. 1.

1 and 3 will be totally reflected, without loss, and pass through the lower face of *B*, through the lens, *L*, of a small telescope to the observer's eye. The ray 2, however, passes directly through the two prisms and out at the left, since at the plane of contact the prisms behave as if made of one solid piece of glass. The eye will therefore perceive a ring of light surrounding a black center, if no light enters the prism *A* from above. But if a ray 4 enters *A*, it passes through *A* and *B* to the eye. If light enters the upper face of *A* and the right-hand face of *B* at the same time, the eye will perceive a central bright disc, due to the light entering *A*, closely surrounded by a bright ring, due to light entering *B*. If the light entering *B* be the stronger, the ring will be brighter than the central disc, and vice versa. If the light entering the two prisms be of equal intensity and of the same color, the disc and ring will blend into one uniformly bright surface, the fine line separating them disappearing. The arrangement of the prism and other parts may be better understood by reference to Fig. 3. *P* is a screen placed between the two lights to be compared. This screen consists of a metal frame, in two parts, fastened together with a piece of tin foil between them. Each part has a circular hole cut through it. When the pieces are fastened together, the holes are filled with plaster of paris, forming even white screens upon which the lights to be compared fall. The tin foil separates the two screens, preventing any passage of light through one screen to the other. The prisms *A B* are so placed that on looking through the telescope, the two faces of the screen *P* may be seen by reflection from the two parallel mirrors *e* and *f*. The combination is mounted, as shown in Fig 1, on a carriage, which may be moved back and forth along the photometer bar, as in the case of the Bunsen photometer. The sighting box, as it is called, is mounted on pivots m_1 and m_2, Fig. 1, so as to allow the observer to turn the box over and take readings in both positions, thus eliminating errors which might result from any differences in the two sides of the screen, or in the mirrors and

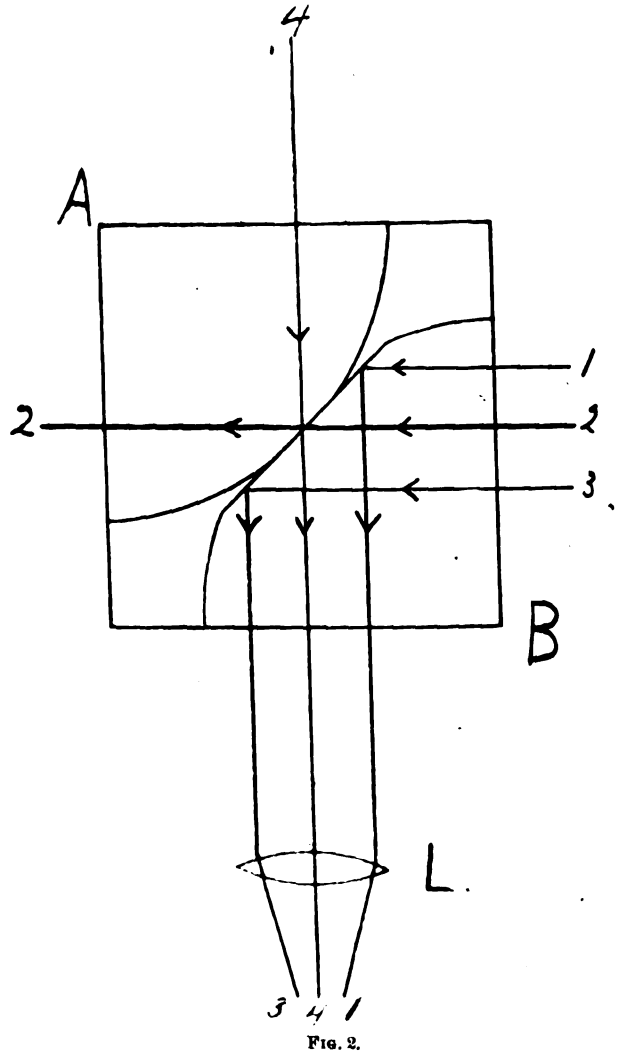

Fig. 2.

prisms. This instrument is quite convenient in use, avoids some sources of error common to the other forms we have described, and is generally considered the best photometer yet devised.

THE WEBER PORTABLE PHOTOMETER.

Fig. 4 shows the external form of this instrument, and Fig. 5 shows an internal arrangement of a slightly different form.

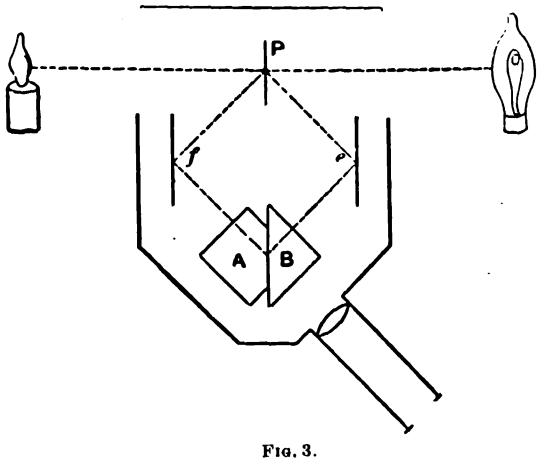

Fig. 3.

A and *B* are two tubes, joined by a closely fitting collar which allows the tube *B* to be turned in a vertical plane. An index fastened to *B* moves over a graduated half circle fastened to *A*,

* Continued from October 15

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enabling one to read the angle, above the horizontal, at which *A* is pointed. In Fig. 5 a small flame is represented at the right end. It is the flame of a small benzine lamp, used as a standard. Back of the flame is a scale graduated in millimeters, fastened on the face of a piece of mirror glass. By means of the scale and mirror the observer adjusts the height of the flame to 20

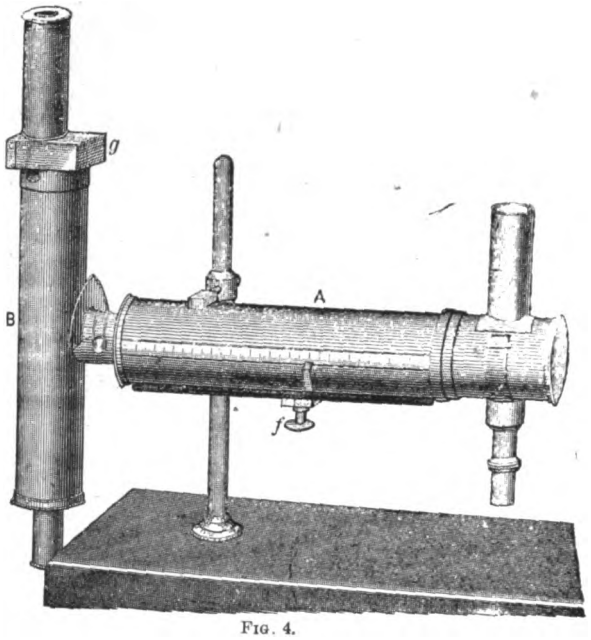


FIG. 4.

millimeters. *S* is a plate of milk glass. *P* is a Lummer-Brodhun prism, as described above. At *m* another plate of milk glass is placed, which is illuminated by the light under test when the tube *B* is pointed at it. The tube *R* cuts off all light except that from the light under test, and enables one with a little care to use instrument in an undarkened room. On looking into the eye-piece a ring of light is seen, from the standard light, surrounding a disc of light from the source under test. The ring and disc are adjusted to equal brightness by turning one of

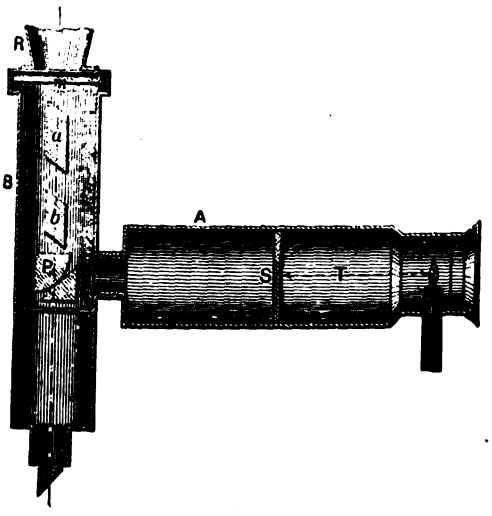


FIG. 5.

the Nicol prisms, *a* and *b*. In the form the instrument shown in Fig. 4, the plate *S*, instead of being fixed as in Fig. 5, is mounted in a frame which may be moved along the tube *A* by turning the milled head *f*. A pointer attached to *f* shows on a fixed scale the distance of the plate *S* from the standard flame, in centimeters. The Nicol prisms *a* and *b* are not used in this form of the instrument. The plate of glass is placed in the box *g*. The candle power of the light under test is found, after making the disc and ring seen at the eye-piece equally bright, from the expression $I = K\frac{R^2}{r^2}$ in which *I* is the desired candle power, *K* a constant, *R* the distance of the unknown light from the tin plate *m* in centimeters, and *r* the reading of the pointer on *f*. The constant *K* is found by readings taken on a standard candle or lamp, at a measured distance from the plate *m*. In order to increase the range of candle power which may be measured with the instrument, several milk glass plates like *m* are provided. In measuring weak lights, one plate only is placed in the box *g*, but with stronger lights, two or more are so placed. A table usually accompanies the instrument, giving the va ues of the constant *K* corresponding to various of combinations of the plates *m*.

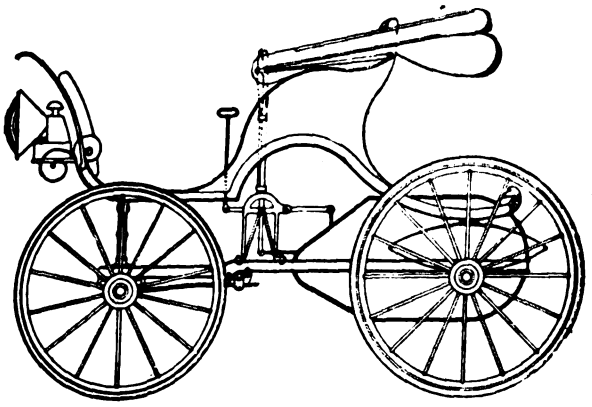
This instrument is quite convenient, especially for the testing of arc lights. Its weak point is the use of the benzine lamp. An error of one-tenth of a millimeter in the height of its flame, causes an error of one per cent in measurements then made. A small incandescent lamp may be substituted for it, if supplied with current by a good storage battery, the current or potential carefully adjusted to the valve used in standardizing it, and the lamp being tested against a standard at suitable intervals, to detect possible changes in its performance.

Brij. F. Thomas.

THE MOTOR VEHICLE CONTEST.

[*Continued from page* 215.]

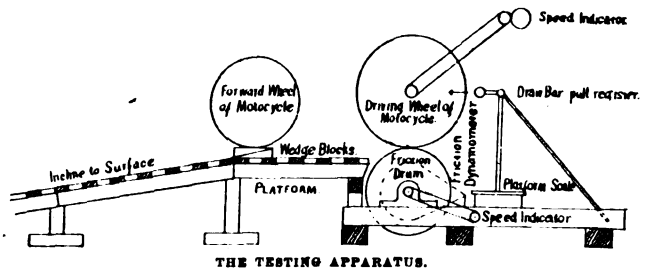
shaft containing two revolving drums and a friction brake. The friction brake is a standard dynamometer and registers accurately the power consumed by the revolving drums and shaft.



THE MAGINN MOTOCYCLE.

The vehicle is also attached to the platform through a dynamometer, which registers accurately the pull it exerts. Revolution counters are attached to the revolving wheels and drums, so that the speed at which the wheels travel is accurately measured at all times.

The weight of the vehicle causes the wheels to adhere to the revolving drums, and the friction is sufficient to tend to drive



THE TESTING APPARATUS.

the vehicle forward as it would upon an ordinary road. This friction is adjustable, and is measured, so that the vehicle may run at full speed and its forward pull will be measured, also the number of miles per hour it would travel. With this device it is possible to measure the load the motocycle will carry, how steep a grade it will climb, the consumption of fuel, the power and the efficiency of the mechanism.

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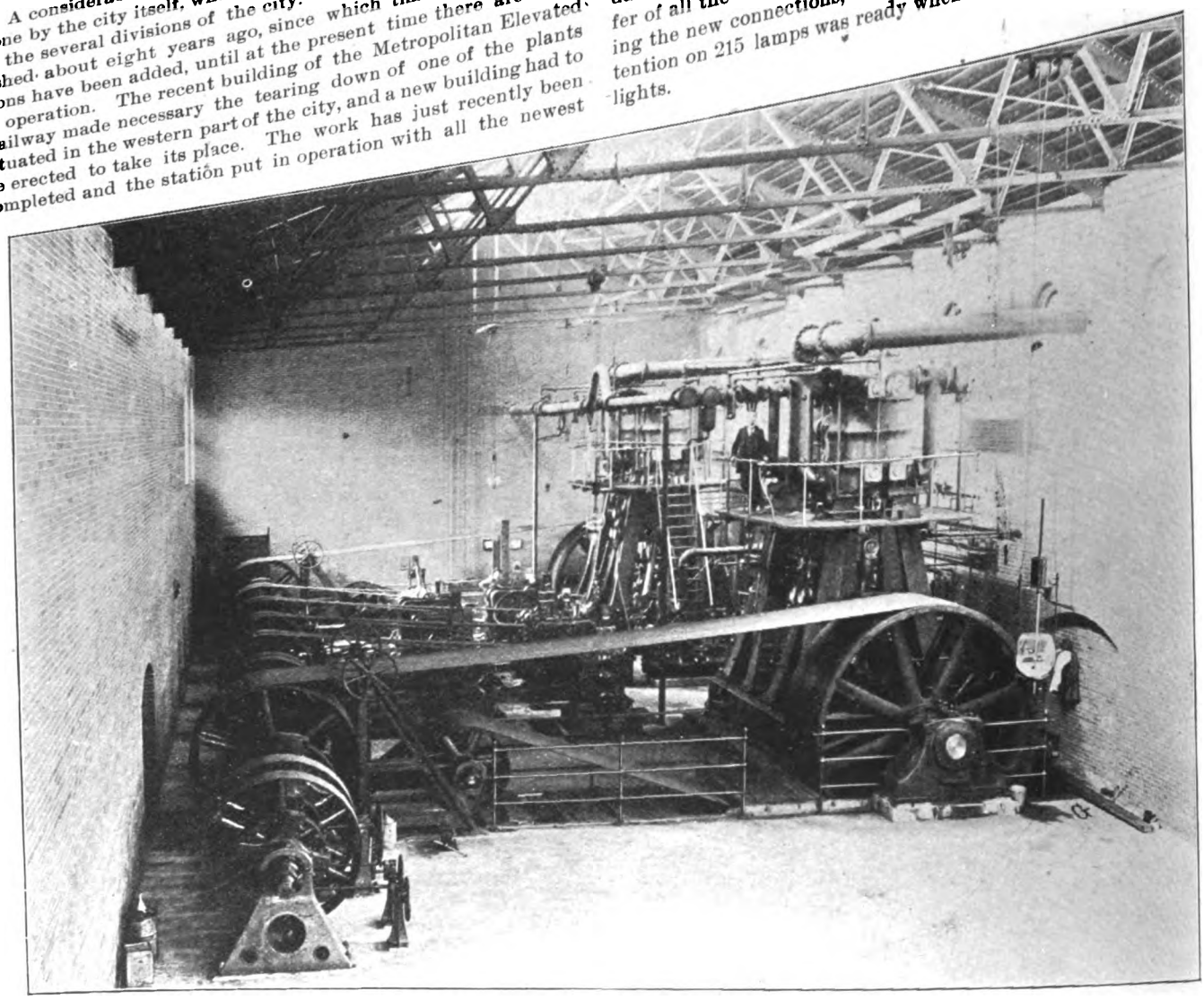
NEW MODEL LIGHTING STATION.

Recently Completed Municipal Lighting Station in Chicago a Model Plant.

A considerable portion of the street lighting of Chicago is done by the city itself, which owns and operates its own plants in the several divisions of the city. The first plant was established about eight years ago, since which time additional stations have been added, until at the present time there are three in operation. The recent building of the Metropolitan Elevated Railway made necessary the tearing down of one of the plants situated in the western part of the city, and a new building had to be erected to take its place. The work has just recently been completed and the station put in operation with all the newest and most approved appliances, and the equipment forms an important addition to the city's lighting facilities. The building is situated at the intersection of Halsted street and Blue Island avenue. It is a one-story structure of grey pressed brick and terra cotta trimmings, the dimensions being 50x207 feet, and the height 36 feet from floor to apex. This space is divided into boiler room, engine and dynamo room, and store room. The boiler room is 39x46 feet square, and is covered with a tile gable roof, supported with steel trussels. The engine and dynamo room is 46x142 feet, and is lined with red pressed brick. The store room is 25x25. The floors throughout are of concrete, while the whole is surmounted by a large smokestack, 8 feet in diameter, and towering to a height of 165 feet. The smokestack is made of steel plates rivetted together, and is lined with fire brick three-fourths of the way up.



CHICAGO'S NEW MUNICIPAL LIGHTING PLANT.

Two water tube boilers of 500 horse-power each forms the equipment of the boiler room, while in the engine and dynamo room are two upright compound condensing engines of the Rankin and Fritch Foundry Company's make, and eight direct connected dynamos, four Brush and four We[illegible] rated capacity of 100 lights each, the lamps being [illegible] c. p. requiring 9.6. amperes. The present requirements of plant are 374 arc lamps, only a partial taxing of the capacity of the machines, and these are operated principally by one engine, the other being held in reserve in case of accident and for the ultimate extension of the service.

During the building of the new station the service was continued from the old plant and in one day between daylight and dark, so that there might be no break in the lighting, the transfer of all the wires were made. The old wires were used in making the new connections, and the entire change from low to high tention on 215 lamps was ready when it came time to turn on the lights.

The wires from the street subway enter a vault in the new plant and from there run to the switchboard, and thence to the dynamos through steel pipe laid under the concrete floor.

A novelty exhibited by the Okonite Company, Ltd., at the American Street Railway Convention in Montreal was a new form of putting up the celebrated Manson tape. The tape is packed in round tin boxes about the size of a silver dollar, and of two colors—red and white, for the black and white varieties respectively, both attractive and neat in appearance and containing one ounce of tape each. Usually this quantity is sufficient for the ordinary repair, and it is thus possible to always have the tape fresh and clean and ready for use at any time. Captain Condee took considerable pride in showing his novelty, and was not only freely complimented upon its practical advantages, but carried home with him evidence of its appreciation in the form of substantial orders.

The recently consolidated system of street cars in Philadelphia embraces what was at one time eighteen distinct lines.

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VOTING BY ELECTRICITY.

A Device Which Registers Votes by a Push Button and Automatically Sums Up the Totals.

Rochester, N. Y., will adopt the Meyers American ballot machine for registering votes at the elections to be held November 5. This will do away entirely with the old method of depositing ballots, and will not only be simple and rapid in in operation, but will in addition show the results already computed immediately after the last vote has been cast. A description of the machine is as follows:

It is seven feet high, five feet long and five feet wide. The voter on entering the cabinet or compartment is alone in an obscure, concealed room, having white walls and which is brightly lighted. He finds against the steel partition a number of vertical columns or "ballot push knobs," projecting three inches from the partition, and painted the same color as the ballot cards beside them To the left of each column of knobs are securely fastened the permanent ballots of each political party (no loose ballots being used or deposited). These permanent ballots contain in large print the name of the candidate and the name of the office to which he is intended to be elected. The ballots for the same party adjoin each other, and commencing from the top are arranged downward in the order of the importance of the office to be filled. This arrangement brings all the candidates for the same office on the same horizontal or cross line, making choice easy. Each particular party has at its head the party name, "Democratic Ticket," "Republican Ticket," "Labor Ticket," etc. The voter pushes the knob inward about two inches, when an unseen retaining latch locks it, prevents repeating and at the same time locks all other "push knobs" on the same cross line, which prevents voting for any other candidate for that particular office. The same result follows after voting for any one candidate on any cross line, no matter what column. A voter can vote rapidly a straight ticket by pushing the knobs of his choice from top to bottom, or he can split his ticket by going to other columns. Any ticket can be voted in ten or fifteen seconds, and there is no reason why the average elector should stay inside the booth longer.

On the reverse side of the steel partition, which is kept sealed until the polls are closed, and opposite each candidate's name, is a mechanical counter, labeled with the same name to identify it after the polls close. No knob can be turned a second time, and it is only returned or released, ready for the next voter, by the elector who is in the booth opening the exit door. This door can only be opened on the inside, and to open it the retiring voter must pass into a vestibule, allowing the inner self-locking door to close, which locks him out of the voting apartment. When the exit door is opened the knobs are released, ready for another voter.

The illiterate vote by color and the blind by the sense of touch. A blind man at Lewiston, N. Y., recently unassisted voted a mixed ticket in eighteen seconds.

When the polls close, the full election board, in the presence of watchers, unseal, unlock, and open the sliding steel doors of the counter apartment, and without touching any of the mechanism (which it is impossible to do), they transcribe the totals to the tally sheet from the plain figures on the dials over each candidates' name.

Several of the leading iron interests of Duluth will be amalgamated, and arrangements made for the smelting of ore by electricity. There are on the Mesaba and Vermillion ranges to-day hundreds of thousands of tons of low-grade ore which will never be used until means are found to smelt it at the mines. Now that this means has been found every pound of it will be used. It is understood that Andrew Carnegie is interested in the new venture, and that with him are associated many of the best known iron men in the country.

A successful test of the electric cable system of canal boat propulsion on the Erie Canal has been made.

ELECTRICAL DISINFECTING SYSTEM.

The new electrical disinfecting system which the Board of Health has adopted and installed in City Hall, was exhibited and explained yesterday by the inventor, Director Beitler. Dr. Bolton, the bacteriologist; members of the Board of Health and a number of prominent medical men were in attendance.

The system differs materially from any employed heretofore. It is assumed that hypochlorites are the superior disinfecting material, because of their power to destroy organic matter, whereas the disinfectants used at present—carbolic acid, bichloride of mercury and sulphurous acid—act only as coagulants.

The new disinfectant consists simply of an electrical invention to decompose sea water, or salt water, forming hypochlorites. It is claimed that the cost will not exceed 40 or 50 cents per 500 gallons of disinfectant.

Previous to the exhibition of the plant the guests were assembled in the Board of Health rooms, where the inventor delivered a lecture to elucidate the principles on which the new system rested. He stated that the value of hypochlorites as an agent for the destruction of organic matter was well known and appreciated. He stated that in the presence of organic matter they are decomposed, liberating chlorine, which seizes on one of the hydrogen elements of the organic matter, and that the ozone which is also formed at the destruction of the hypochlorites, oxidizes and disintegrates the remaining portion of the organic body, thus completely destroying it. In order to show the non-poisonous qualities of the new disinfectant, the inventor swallowed some of it. Its action in completely destroying albumen was shown in comparison with the coagulating effects of sulphurous acid, carbolic acid and bichloride of mercury.

Subsequent to the lecture an inspection of the plant in the basement was made. A large vat containing salt water had been constructed, and into this was dipped the two poles of an electrical dynamo. The water was rapidly disintegrated and the disinfectant formed.

The action of the electric current, as it is conveyed by the electrodes through the salt water, is to decompose the salt water. In this decomposition chlorine and oxygen are liberated at the positive pole, while hydrogen is set free at the negative pole and escapes. Sodium is also deposited at the negative pole. The oxygen and chlorine enter into combination with the sodium at the negative pole, forming the hypochlorites. A current of 1100 amperes, six to seven volts, which represents about 7700 Watts, which is about ten horse power, was used. An economical horse power per hour should cost about ¼c, making the cost total in the neighborhood of 7 cents per hour. As it takes three hours to manufacture the disinfectant the cost would be about 20 to 25 cents for 500 gallons for energy. Add to this 20 cents for the cost of the salt and the total cost for manufacturing would be from 40 to 50 cents for 500 gallons.

A piece of putrid meat dipped into the disinfectant for thirty seconds was rendered free from all obnoxious smell.—*Philadelphia Press.*

CALCULATED POWER OF LIGHTNING.

It is no doubt interesting to express the force of a stroke of lightning in horse power. During a recent storm which passed over Klausthal, Germany, a bolt struck a wooden column in a dwelling, and in the top of this column were two wire nails 5-32 inches in diameter. The electric fluid melted the two nails instantly. To melt iron in this short time would be impossible in the largest furnaces now in existence, and it could only be accomplished with the aid of electricity, but a current of 200 amperes and a potential of 20,000 volts would be necessary. This electric force for one second represents 5,000 horse power, but as the lightning accomplished the melting in considerably less time, say one-tenth of a second, it follows that the bolt was of 50,000 horse power.—*Dr. C. Grottewitz, Barmer Zeitung.*

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

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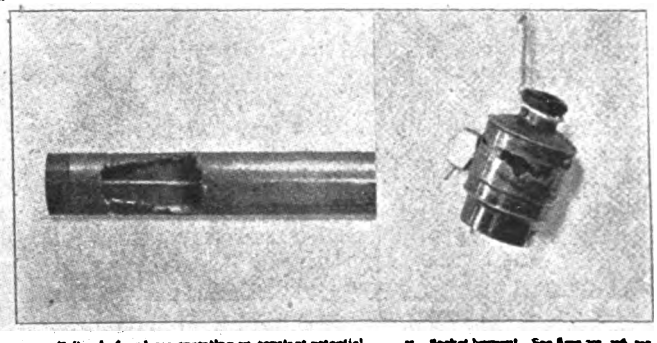
ELECTRICAL FIRES.

Synopsis of Quarterly Report Issued by the National Board of Fire Underwriters.

The National Board of Fire Underwriters, through their electrician, Mr. W. H. Merrill, Jr., has issued a statement showing the number of fires reported to the Board as due to electricity and covers a period of three months—July 10 to October 10. It gives also the direct cause of each fire, as near as could be ascertained. Mr. Merrill says his report does not constitute a complete list of electrical fires throughout the country because there are sections from which reports cannot be promptly received and because there are fires where every evidence of the origin is destroyed. During the period named 138 fires have taken place and the direct causes have been varied. The losses, however, have been nominal in almost every case, indeed the majority have ranged anywhere from $5 to $100. A fruitful source of damage is attributed to crosses between telephone and electric light wires, though the losses in such cases have been very small. The heating effect of incandescent lamps also was responsible for several fires, while the sparking of arc lights has a number of losses to its credit. Many fires, too, are attributed to imperfect iustallations, and it is perhaps, in this connection that the reports issued will be of special service in pointing out the necessity for having all wiring thoroughly done and properly inspected before turning on the current. A series of cuts showing characteristic turnouts, and which are here reproduced, accompany the report.

CHARACTERISTIC BURNOUTS. (GROUP III.)

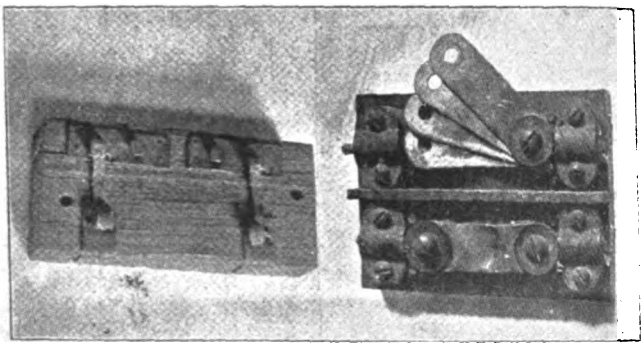
Supplement to Fire Report No. 9. Electrical Bureau of the National Board of Fire Underwriters.



20. Tall rod of arc lamp operating on constant potential circuit burned through by contact with lower carbon.

21. Socket burnout. See fires 705, 706, 707, 708, etc., and Laboratory Report No. 152.

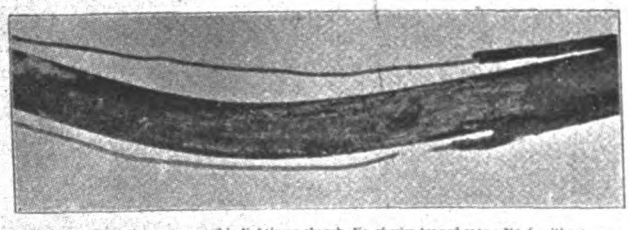
Photos from the Boston Fire Underwriters' Union, Geo. W. Wilson, Electrical Inspector.



24. A home made cut-out. Size 2 inches by 4½ inches. Constructed of hardwood. The contact strips are made of sheet iron and the fuse metals of lead strips very loosely held in place by double pointed tacks. Circuit connections are expected to be made under the wire nails shown driven through the iron strips.

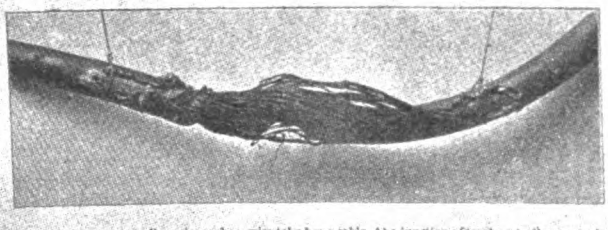
25. Wonder base cut out fused for 15 amperes introduced in circuit to protect a No. 1 wire whose safe carrying capacity in open work is 150 amperes. At the time this device was discovered it was carrying 210 amperes of current. The woodwork underneath the terminals is very badly charred.

Specimens from the Board of Fire Underwriters of Allegheny County, J. A. E. Hoeveler, Elect'l Insp'r.



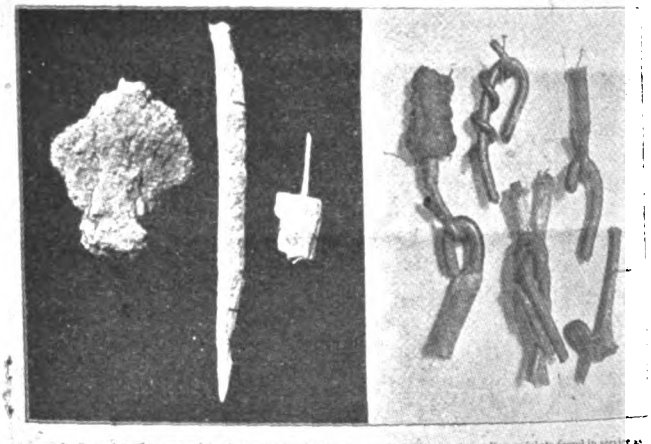
22. Edison three wire system used in lighting a church. No. 16 wire tapped onto a No. 6, without any cut-out. One of the wires became grounded on a gas pipe on a brick wall, arced until it burned a hole through the pipe and ignited the gas. The fire followed the furring and communicated with the joists above, but was immediately seen by the janitor, who sent in an alarm. Extinguished by a chemical stream. Damage, $150.

Photo from the Michigan Inspection Bureau, Wm. T. Benallack, Electrical Inspector.



23. Cross between a trolley wire and 104 wire telephone cable. At a junction of tracks a trolley car took the wrong track and was pushed back without the trolley having been pulled down. The trolley caught in a frog and lifted the line until it came in contact with the telephone cable extended over it. The lead covering of the cable was burned through as shown and the current followed the telephone wires into the telephone exchange. Protective devices located here operated and prevented damage to the switchboard.

Photo from the Kansas Advisory Rate, Fire Map and Insurance Information Bureau, Chas. E. Eldridge, Inspector.



26. Samples of return wire of trolley road taken from made land not far from salt water. All of the wires were originally 0000. The specimen on the right now measures less than a No. 5 wire, the one on the left shows no metallic copper remaining and the one in the middle shows a wire wasted down to an arcing point. All of the specimens as shown are thickly coated with a salt of copper of a bright green color.

27. Some extraordinary joints found in service as shown.

Specimens from the New England Insurance Exchange, J. Coulliard, Electrical Inspector.

Specimens from the Board of Fire Underwriters of Allegheny County, J. A. E. Hoeveler, Elect'l Insp'r.

The subscription price to THE ELECTRICAL JOURNAL is $2.

THE GODDESS "ELECTRA."

A new goddess is born, says the Nashville American. She is called "Electra." She is the goddess of all work. She is swifter than Mercury, and brighter than the star of the morning. On her brow is a blaze of jewels; she carries a flame-tipped wand. Her garments are of woven rays of light, garlanded with flowers, red, blue and green.

She comes to unbind burdens, to succor women and horses. There is no service so exalted that she cannot attain to it, no service so lowly she will not stoop to it. She will light the kitchen fire and cook the breakfast. She will wash the dishes and scrub the floors. She will curl and brush the hair. She will sweep the room and run the sewing machine. She will run errands and draw the cart. She will pull and fill the teeth, be the physician and put the weary to sleep. She will play on the piano, or the wash-tub, as desired. She will amuse the children or entertain the company. She will tend the door or convene the elements. She will manufacture climate to order, and bring Alpine blasts in midsummer to a city flat.

NECESSARY TO SUCCESS.

A French general upon being asked by Louis XIV what he required to carry on war successfully, replied: Three things, your majesty; first, money; second, more money; third, always money. And so with the business man. If he is intent upon making a conspicuous and continued success of his business he must first advertise; second, do more advertising; and third, continue to advertise. The mere suggestion is probably all that is necessary. THE ELECTRICAL JOURNAL'S columns may be advantageously used for that purpose.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

Berlin has more telephones than any other European city, the number being 25,000.

In three months the New Telegraphers' Aid Society paid out $1,307 for sick and death benefits.

There are said to be 1,279 distinct sections of ocean cable in existence, aggregating in length 157,674 nautical miles.

The telephone in the United States is used on an average, ten times, and the telegraph, once, by the entire population of the United States.

The last annual report of the Western Union Telegraph Company shows an increase in net revenue over the previous year of $348,904.

In Chili the telegraph service is under the control of the State, as in England. During the past year 830 miles of line were reconstructed, and 340 miles of new line erected.

Direct telephone communication has just been established between Belgium and Germany, Antwerp and Cologne being the extreme points between which conversation can be carried on.

The Compagnie Francaise des Cables Telegraphiques has received from the Venezuelan government, fifty year exclusive franchises, one being for cable communication, direct or indirect, between Venezuela and the United States, and the other for cables on the Venezuela coast.

Light and Power.

Threshing grain by electrically transmitted power is in vogue among the farmers of Sweden.

Fort Wayne, Ind., during the recent centennial celebration, made a brilliant display of electric lighting.

Commissioner of wires, Murphy, of Boston, has reported adversely on the use of iron poles for conveying electric light wires.

A cartridge factory in Lugansk, Russia, with an annual capacity of one hundred million small-bore cartridges, uses electricity for motive power.

Rockford, Ill., has purchased the Chick Mill property and 3,400 inches of water-power for the sum of $30,000, and will build a new 400 arc light city lighting plant.

The great electric furnace at Niagara Falls for the manufacture of carborundum was first supplied on the 19th inst. with current representing 1,000 horse power.

Dr. Gebhart, of Budapest, says incandescent lamps placed in shop windows at a low level are very destructive to the eyes. They should, he says, be put out of the direct range of vision.

Several African chiefs visiting Liverpool, Eng., were so struck with the novelty of the electrical apparatus of the Liverpool Overhead Railway that they dubbed the chief engineer of the plant "The King of Lightning."

Fort Worth, Texas, is agitating the building of a large electric power plant near some of her adjacent extensive coal fields and the transmitting of the power thus obtained to the city for lighting and manufacturing purposes.

Mayor Allen, of Columbus, O., has vetoed an ordinance granted to the Citizen's Electric Light and Power Company, because it provided for the stringing of overhead wires. He insists that the wires shall be placed underground.

The Pennsylvania Heat, Light and Power Company, of Philadelphia, has leased for ninety-nine years the property of the Edison Electric Light Company, guaranteeing an eight per cent. dividend for two years, and nine per cent. thereafter.

In a suit instituted by the Jacksonville Gas and Electric Light Company, of Jacksonville, Fla., against the city to enjoin them from operating an electric light plant for commercial purposes, judgement has just been given by the Supreme Court of the state in favor of the city.

A man in Sacramento, Cal., climbed into a tree to trim off some limbs which interfered with trolley wires of the street car company. The limb, when partially sawed off, fell across the wire and established a connection which acted as a conductor, and gave the man a shock sufficient to knock him off the tree.

The Karnival Krewe parade recently in Kansas City was such a success, financially and otherwise, that it will be repeated again next year on a much extended scale. Among other features planned are the illumination of the city by triumphal arches of light, and the running of chains of gaslight and electricity with colored globes along the line of parade.

A dispatch from Ukiah, Cal., says that a peculiar electrical phenomenon occurred there a few days ago, when the sky was clear and the stars shown brilliantly. There were no traces of rain or clouds, yet the southern horizon was brightly illuminated by intermittent flashes of lightning, which lasted until 12 o'clock. The display was witnessed by hundreds. It was a phenomenon never before seen in that locality.

At a meeting of the common council of Jamestown, N. Y., held October 14, the Board of Public Works recommended that improvements to the extent of $6,000 be made at the municipal light plant for the purpose of further increasing the incandescent part of the plant for commercial lighting. According to the report of the Board, this amount would give 2,000 additional 16-candle power incandescent lights, which would produce a gross income to the city of $14,000 per annum. The additional cost of operating the plant would only be $4,400, giving a net revenue to the city of $10,000 per annum. The report was discussed and referred to the electric light committee for further investigation.

Railways.

The electric hearse has made its appearance in Milan. A specially constructed car serves for a hearse, the mourners following in a passenger car.

A corporation to be known as the Canadian Electric Railway and Power Company will apply for incorporation at the next session of the Dominion Parliament, says the Railway Review. They will ask for power to build, operate and maintain an electric railway from Montreal to Windsor, running through Brockville, Kingston, Belleville, Toronto and London, and with power to build branch railways for a radius of 25 miles from the main line. They will also ask leave to lease all existing roads, to dispose of electricity for power or heating purposes, and to have full right to perform all undertakings of an electrical company.

General News.

In the aristocratic neighborhood of Fifth avenue New York, an explosion of escaping gas occurred on the 16th inst. The escape was under the sidewalk, and the gas is said to have been ignited by an electric current.

The American Horseshoers' Protective Association, at a meeting held in Detroit, October 16, discussed the effect upon horseshoeing, of electricity and the bicycle. The conclusion arrived at was that electricity was supplanting the horse, but that the bicycle was not giving any special cause for alarm.

Dr. H. H. Hoppe, a leading physician of Cincinnati, and who has served most efficiently as instructor of the electro-therapeutic class of the National School of Electricity in that city, was married on October 16 to Miss Hermine Richard, THE JOURNAL extends its congratulations to Dr. Hoppe and his "better half."

Mr. J. Glen Wray, chief of the laboratory department of the Bell Telephone Company, and who also is an efficient instructor on the staff of the National School of Electricity, has taken unto himself a life partner in the person of Miss Carrie Williams, of Chicago. The bride is a very estimable lady, popular in her circle of friends and acquaintances, and THE JOURNAL, in addition to saying "Hoo-wray," extends its felicitations and good wishes. Mr. and Mrs. Wray enjoyed a three weeks' bridal tour among the resorts of Wisconsin.

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ELECTRIC RAILWAY SIGNAL.

Audible Block Signal Warns Railroad Engineers of Approaching Danger.

Five miles of the Chicago and Eastern Illinois Railroad have lately been equipped with the audible block signal, an invention which, it is said, will prevent 95 per cent of the railroad disasters. The system was shown in practical operation recently to a number of expert electricians, railroad men and others. A number of prominent Buffalo people were in the party and took a special interest in the test of the new device, it being the invention of a Buffalo man, says the Chicago Tribune.

The test was entirely satisfactory, and it was found to work even better in actual operation than the model. After the trial was finished it was decided to incorporate a company.

It has been in use on the five miles of road for several weeks and President Carpenter, of the Eastern Illinois, says up to this time it has done all that is expected of it.

It was shown at the test that the system will give timely alarm to the engineer of a moving train when approaching a standing or moving locomotive on the same track, and of an occupied grade crossing, an open switch or drawbridge, or a a car projecting from a side track over a main track.

As the signal given is the ringing of the bell in the cab of the locomotive, which will continue to ring until stopped by the engineer, it is apparent that the system is certain to be as effective in darkness as in daylight, or during fogs and rainstorms, on curves of heavy grades, where a visible signal could not be seen in time to avert a disaster.

In the operation of this signal one of the rails is made a continuous conductor by connecting the rails electrically at the joints. The other rail is divided into sections or blocks and provided with electrical connections which extend from one block to the other. At opposite ends of the blocks are placed electric contact pieces, each formed of two plates insulated from each other and provided with vertical ribs arranged diagonally. These ribs lie in the path of an arm or brush carried by the locomotive. Upon the locomotive is placed a battery and alarm mechanism.

The form of the contact plates in the roadbed between the rails will vary according to circumstances. In climates where they have much snow they will be separated and formed of long, thin strips of galvanized iron, a quarter of an inch in thickness, so as to be out of the way of the flanges used by the railroad. On roads which have water scoops on their engines this style will also be used so as not to interfere.

The arrangement of the circuits is such that when a train is passing in one direction the arm or feeler strikes a set of contacts controlling the circuit arranged for trains passing in that direction. When the train passes in the opposite direction the feeler strikes the opposite contact plate, securing opposite results. The feeler or brush, which extends downwardly from the pilot of the locomotive, is capable of swinging laterally, and is protected so that it is not injured by the shock due to striking the contact plates or other objects lying on the track.

The connection between the continuous and the sectional conductors is made by the wheels and axles of cars or locomotives standing thereon, and when such connection is made upon the distant block, the signal is sounded upon the locomotive standing or moving upon the block which is connected with it upon contact being made by means of the wheel and contact plates. The same result follows in the case of a car upon a side track projecting upon the main track.

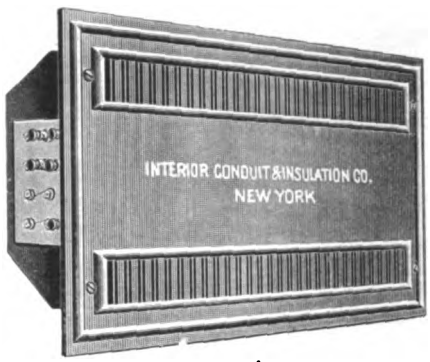
In case of a wreck such that connection otherwise is broken, an alarm may be given to an approaching train by simply making any kind of electrical connection between the rails, as by an iron bar or piece of wire.

By means of a switch instrument located at any convenient point, or at a station, and below the crossing, communication may be had by roadmasters with approaching trains to give warning upon unsafe condition of track.

A NEW ELECTRIC CAR HEATER.

The Interior Conduit and Insulation Company of New York have introduced this season an electric car heater which embodies great improvements in this class of apparatus.

A much higher efficiency has been obtained in these heaters over other machines which have heretofore made their appearance, and this economy of operation is by far the most important factor which is considered by any railway company. All the electric energy absorbed by any electric heater is converted into heat units, and it has, in consequence, been assumed by many that electric heaters are of necessity of equal efficiency, but this is not the case. It is not sufficient merely to create

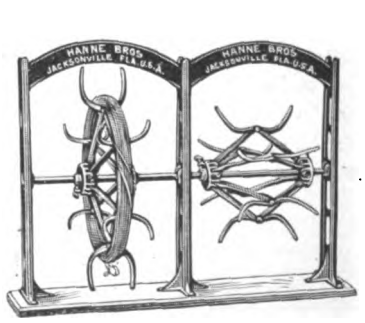


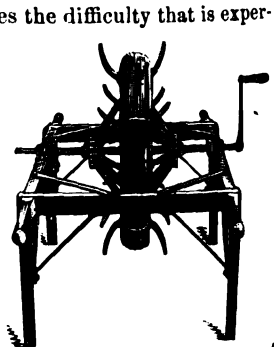
heat, but also to utilize it to the best advantage, and in order to do this it is imperative that the heat should be distributed and circulated where it is needed and as fast as it is generated. No other electric heater has heretofore been constructed that will do this. In other heaters a large proportion of the heat produced has been non-effective for any useful purpose owing to lack of proper distribution, as most of the air current passes around the coils, leaving the heat dormant, and the case of such heaters absorb a large quantity of heat, so much so that in some instances fire has been caused, endangering the lives of passengers. Such machines require from six to twelve amperes at five hundred volts to sufficiently warm the car.

In the heater manufactured by the Interior Conduit and Insulation Company, a continual circulation of air is maintained. All the air passes through the coils, and all the heat generated is carried off and distributed into the body of the car, the case of the heater remaining perfectly cool. There is absolutely no waste, and consequently a much higher degree of efficiency is obtained than has hitherto been practicable. These heaters are thoroughly well made, neat in appearance, easily installed and amply guaranteed.

LITTLE GIANT REEL.

Hanne Bros., of Jacksonville, Fla., are the inventors and manufacturers of an adjustable combination wire reel, the practical and useful character of which will at once commend itself to handlers of wire. It obviates the difficulty that is exper-





ienced where wire is handled in the coil without any means of keeping it from kinking or cracking, and the price of the reel is such that the saving effected by its use will soon repay the investment. Messrs. Hanne are exhibiting their reel at the Atlanta Exposition, where it is attracting considerable attention.

Send in your subscription to THE ELECTRICAL JOURNAL.

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ELECTRO-THERAPEUTIC DEPARTMENT.

FUNCTIONAL NERVOUS DISEASE.*

Static Elcctricity Very Beneficial in Certain Cases—In Others Quite Useless.

The following short résumé of my experience of the treatment of functional nervous diseases by static electricity is presented with the hope that the "Fellows" will fully discuss the subject, and thus add much knowledge in the way of personal experience.

I will endeavor, first, to state, in as concise a manner as possible, a class of cases, the treatment of which by static electricity has proven useless. The method of treatment will also be given. I will then relate the class of cases that have been benefitted by this form of electricity, together with a description of the methods which, in my experience, have proven the most useful.

The apparatus used may not be new, and perhaps it is not, but so far as I am aware, some of the ideas originated with me. As to the causes of failure to relieve the following conditions, I am anxious to attribute the want of success more to imperfect methods of application than to any lack of curative power in static electricity, and I trust that the experience of my friends will aid in the treatment of these cases in the future.

I treated a case of spinal irritation with tender points on right side of spinal column from the occiput to the lower lumbar spine, with tenderness of all the muscles of the side supplied by the nerves in this area. This case had been standing for years, and among other methods, she was treated by static insulation and the static direct spark before coming to me. She stated that in every instance her trouble was intensified by the static current. I tried her with the breeze from the wooden ball several times, but she complained so bitterly of increase of pain that it was discontinued.

I have never yet succeeded in even temporarily relieving a case of sciatica of any kind, from any cause, known or unknown, by static electricity. I have tried the spark, direct and indirect; the wire brush; the wooden ball, and the roller, as well as the static induced current.

In writers' cramp my experience has been the same as in sciatica.

I have failed to relieve trigeminal neuralgia, as well as cervico-occipital neuralgia, with the static current by any method with which I was at the time familiar. Since then, however, by the aid of two induction coils, constructed by myself, and suspended from small Leyden jars, a static current of great tension and exceedingly fine vibration is induced, and with this current two cases of neuralgia of the ulnar division of the brachial plexus have been relieved. It is hoped also to find it successful in some of the cases where static electricity formerly failed. I do not know that the idea of these coils or their use is in any way new to others, but to me they are quite new. I certainly have never seen them used before.

These coils are made of twenty-two or twenty-three turns of heavily insulated No. 6 copper wire for the primary coil; this in turn is wrapped in several thicknesses of manilla paper, which has been thoroughly soaked in linseed oil; around this is wound fifty feet of small copper wire, heavily insulated, forming the secondary coil. These coils are suspended from small Leyden jars by a hook on the end of the primary coil, and the conducting cords are attached to lower end of secondary coil, the patient getting the current by induction. This static induced current has been found very useful in the treatment of acute inflammation, especially sprains and rheumatic pains in the joints. A very soothing effect is produced in the nervousness and insomnia accompanying cerebrasthenia. The patient is placed upon the insulated platform which has been supplied with a metal cover; one pole is attached to this cover; a bifurcated cord is fastend to the other pole; two metal handles are attached to these cords, and these the patient holds in his hands. His shoes are removed to prevent pricking of the feet by the current following the tacks through his shoes. The current is now turned on until a gentle thrill is felt in the hands and feet. In from five to fifteen minutes a sensation of drowsiness and comfort comes over the patient. This feeling often lasts several hours and is followed in many cases, after the first treatment or two, by sleep more or less continuous and refreshing, which before has been often short in duration and unrefreshing. Stronger currents may be obtained by using larger Leyden jars.

By modifying the static current in this way, it is possible to use it in painful conditions of the female pelvic organs with good results.

I am now using with great benefit in functional nervous diseases a "static cage" such as Dr. J. H. Kellogg, of Battle Creek, Mich., mentioned during the session in New York last September as having used with benefit. The wire cage is attached to one pole of the battery and the metal covered platform to the other. Dr. Kellogg uses metal points in his cage, but in mine I use tinsel brushes. The idea of tinsel brushes and metal covered platform is, to the best of my knowledge, original.

The patient stands or sits with his feet in the metal cover and the cage is lowered over him from the ceiling. One prime conductor is attached (by means of a heavily insulated wire) to the cage; the other prime conductor is connected with a metal cover by similar means; the poles are now separated and the machine put in motion. A perfect shower of electricity in the form of a cool spray from every tinsel brush now flies to the patient, producing a most delightful sensation; at the same time the patient is surrounded with an atmosphere of ozone. Now stop the machine and approximate the poles, then start it again and gradually separate the poles, the entire body is at once subjected to a rapid succession of mild shocks, so that every fiber of the body may be said to be in a state of rapid vibration which in a short time produces a comfortable sensation of warmth. In administering this vibratory current, if the shoe soles are thick or dry, the current, in overcoming the resistence, reaches the foot in the form of a spark which renders the treatment uncomfortable, but this can be readily obviated by the patient removing his shoes.

This cage is used with much satisfaction to myself and benefit to those patients suffering from functional nervous troubles and in many cases relieving the distressing symptoms of an organic disorder. The moral effect in the majority of functional nervous diseases is seen at once. The physical effect is soon noted by the appearance of the patient.

A case in point—A young lady was sent home from a seminary in consequence of a severe Chorea Minor, complicating Chlorosis. She was placed in the static cage and given the static shower bath for ten minutes; during this time she was made to inhale deeply and regularly the electrified atmosphere which surrounded her. The poles were then approximated and the oscillating current, as strong as she could comfortably stand, was given for ten minutes. At the end of the treatment she would invariably come out of the cage with rosy cheeks. At the end of three weeks her menstrual function was re-established; the Chorea was gone; the Chlorosis had disappeared and she went away feeling well and happy. This case was treated daily.

Neurasthenic and hysterical cases are treated by this method with great benefit. Of course, any local trouble should be properly treated.

The tonic effect is most surprising. The weak and anaemic are more quickly and more pleasantly restored than by any course of iron. The digestion is improved; the weight increased; the equality of the vascular and nervous system is

*Paper by Dr. Francis B. Bishop, of Washington, D C., read before the Toronto Convention of the American Electro-Therapeutic Association, September 5, 1895.

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established, and in many cases of functional nervous diseases, the patients are perfectly restored in a few months. Many cases could be given in detail, treated beneficially by this method, but time will not permit. In brief, however, it may be stated, that the static oscillating current can be used with great benefit where general faradization, as introduced by Dr. Rockwell, is indicated; but where the removal of the clothing could not, or would not be tolerated.

During the past winter, several lady school teachers have been under my care, who, notwithstandieg they came in a nervously prostrated, and, in a majority of cases, anaemic condition, continued to teach during the entire session, gaining in weight, strength and spirits. They were all treated in the Static cage,

Dr. Kellogg has suggested the use of a larger static machine than those in ordinary use. No doubt, for some cases, the suggestion is good, but by economizing the current by the aid of the heavily insulated wire conductors and by using the metal cover for platform, I find that, generally, there is more current than necessary from the usual sized machine.

These, Mr. President, are some of my experiences with Static Electricity in the treatment of functional diseases of the nervous system by means of the Static cage and induction coils.

They have prompted me to place before the association this brief paper for discussion, firmly believing that all who will give these appliances a fair trial will be pleased with the results, and will find them capable of doing very much more than has been claimed for them.

URETHRAL STRICTURE.*

Criticism of the Mode of Treatment by Electrolysis Employed by Dr. Gautier, of Paris.

It is my unpleasant duty to protest against the new (?) electrode and mode of treatment of urethral stricture by electricity, as advanced by Dr. George Gautier of Paris.

The new electrode he describes, is neither new nor an improvement. The gum instrument has been a failure thirty to forty years ago, and has been abandoned because it was too elastic and its progress could not be directed by the operator. The next objection is "a tip screwed on to it 1½ centimeters." All screws are uncertain and may unscrew themselves sometimes; they ought never to be used in urethral surgery. Dr. Gautier uses a current of from 10 to 20 milliamperes, which is too strong, and almost always will by its cautery action do mischief and often ruin the patient beyond any repair.

"Before withdrawing the electrode we turn off the current and the patient empties his bladder." Here are two more mistakes. The electrolysis will act best during the slow withdrawal of the electrode, and when that electrode has passed all the strictures, then the current ought to be slowly reduced to zero and the instrument removed. The ingress of the electrode absorbs some of the indurated tissues of the stricture but will do more absorption on its return. Second. Emptying the bladder will also remove the products of electrolysis, a plug of organized hydrogen, which protects the walls of the urethra. It is very important to abstain from micturating as long as possible in order to retain this protecting cover of the mucous lining.

It is a mistake to use a catheter the next day and each day following. After the electrolysis has been used, absolute rest is necessary until the mucous walls have been restored and the electric action exhausted. Local interference with any instrument retards the restorative process and is positively dangerous and contraindicated. The interval of ten days between seances is the only rational advice in the procedure given.

I began my operations on urethral strictures by electrolysis in 1867. Then I used the flexible bougie, but soon abandoned it and gradually improved my electrodes until they were perfect. Four different sets have been made and are fully described in different journals at different times.

For years I have experimented with all kinds of instruments and soon came to certain conclusions, as follows: Sounds for the correct exploration of the urethra must be either entirely flexible or stiff and unyielding. To the first class belongs Nelaton's and Jaques' and they adapt themselves to the curves and inequalities of the urethra, while these flexible instruments may be useful for catheterization and drawing off the urine, they fail utterly in electrolysis, because the hand of the operator can neither guide nor feel the progress the electrolysis makes. The type of the second class of explorers is the stiff and unyielding—like the steel sound. The operator has it in his grip and will guide the electrode where he pleases, it will not diverge from the course in which it is directed, it is firm, never yielding. If such an instrument makes a false passage the operator is responsible for the damage done. On the other hand the success depends mostly on the skill with which the operator guides his instruments through the curves of the urethra and through the strictures. The curve of the electrode is not so material, but a short curve is preferable, because the operator can guide with his hand and adapt thereby the instrument to the curves of the urethra. The tunnelled electrode must have a short curve and the tunnel must be at its end. The guidance of an instrument can be done with a certainty only in a straight line, the more the opposite end diverges towards the curved line of a circle, the less will it be influenced by the force at the straight end. The old gumelastic bougies and catheters bent in different places on being introduced, assuming a progress in a different direction when the operator wanted it to proceed. Nobody could guide such gum instruments in a direction wanted, and therefore the gumelastic electrode is the worst instrument for a scientific electrolytic operation, and has been abandoned by the author more than twenty years ago.

The writer has described his sets of electrodes before societies and the description with cuts has appeared in different journals. He has practiced his method successfully for nearly thirty years in thousands of cases and has published statistics of 1755 cases, which have been compiled from records of his own and other operators. Re-examinations have shown that after years, in some cases, eleven to eighteen years, no relapses have taken place. Such experiences and records will stand as facts, certainly better than the report of "six cases recently treated" by the "new method." It is a pity, that a well established method for the cure of urethral stricture by electrolysis is in danger, and sometimes misunderstood, by untimely outbreaks of socalled new methods and new instruments; but some people feel chosen, even to correct the alphabet. Most reluctantly these statements have been made with the only desire to benefit humanity and warn the profession against socalled innovations, which in fact have been old and abandoned long ago.

If bad management or wrong methods of electrolysis sometimes are apparently successful and have no bad consequences to patients, it does not prove that a bad management is good, nor will a mismanaged case prove that a good method is bad.

* Paper by Dr. Robert Newman of New York, read before the Toronto Convention of the American Electro-Therapeutic Association, September 5, 1895.

The electro-magnet has been successfully employed in the removal of iron particles from the eye by Dr. S. Mitchell of Hornellsville, N. Y., who writes to the Medical Record as follows: "I should not feel that I was prepared to deal with these cases unless an electro-magnet was a part of my armamentarium, and by its use perhaps save performing an iridectomy as well as removing the offender with greater ease. In those cases where there are strong probabilities that a piece of steel or iron is lodged in the vitreous chamber, a search with the electro-magnet is often rewarded by the removal of the particle and the saving of the globe. And, although there may remain no useful vision, it is much better than an artificial eye, and the prospects that it will become a dangerous companion are very slight.

I am now using the Edison incandescent light circuit in my office, and by means of a converter I am able to use it for all kinds of galvano-cautery work. To this converter I attach my electro-magnet, and find that it has a much stronger attractive force than with any storage battery that I have ever used."

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ALESSANDRO VOLTA.

Eminent Physicist. Born at Como, Italy, 1745. Died 1827. Discoverer of the Voltaic Cell and Voltaic Pile. His name was given to the Unit of Electro-motive force.

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The Electrical Journal.

Vol. 1. CHICAGO, NOVEMBER 15, 1895. No. 12

HEATING CARS BY ELECTRICITY.

Street Railways Using the Current for Heating Purposes Consider It Specially Well Adapted for the Purpose—Clean, Safe and Convenient.

STOVES AND HORSES ARE CLASSED TOGETHER.

There is hardly any question bearing upon street railway management at the present time which is of more interest, alike to the companies and to the public than that of heating the cars during the winter months, and both are interested in arriving at the best and earliest solution of the problem. The public are interested, it may be said, only in having the cars thoroughly warmed, the item of cost being a matter of no special concern to them; while the companies, on the other hand, will pay more or less attention to the cost involved as well as the efficiency of the appliances used. Before the advent of the electric car the coal stove was the only means by which the cars could be heated, but now that the electric current is available for that purpose also, the questions arise, Is it capable of being satisfactorily used? Will it furnish the required degree of heat, and is the expense within such limits that it can be used with a due regard to cost of operation?

Everybody knows what coal stoves will do because they have been in use so long, but what may be expected of electricity is not so well defined, and there is perhaps no better way of forming an intelligent opinion than weighing the testimony of those companies which are using the current for that purpose. It was with a view to furnishing the readers of THE ELECTRICAL JOURNAL with some reliable information on this subject that a letter was addressed to a limited number of railways which were known to be using electricity for heating purposes. Assuming that heating by electricity was more expensive than by coal stoves, one of the questions asked was whether the increased cost was compensated for by increaed patronage which might naturally be expected as the result of placing the cars in shape to compete with existing steam roads which, by steam heat or hot air keeps their cars clean and comfortable. The following are some of the answers received, several being unavoidably held over until the next issue of THE JOURNAL:

ST. JOSEPH AND BENTON HARBOR ELECTRIC RAILWAY AND LIGHT COMPANY.

ST. JOSEPH MICH., November 8, 1895.

Your letter of the 7th inst. came duly to hand. I find that by heating cars with electricity I remove the risk of burning cars and barns at night. I remove the unsightly spectacle of a street car going down the streets with smoke flying from a small pipe, having the appearance of a Power Station smoke-stack. I get rid of the obnoxious gas smell in the car, and the conductor is not compelled to replenish the fire with coal every trip.

I am using electric heaters with very satisfactory results as to uniform temperature of the car, and when a conductor attends to his duty by moving the switch to the different points of intensity, I get very satisfactory results both for the company and the passengers.

The cost is above the cost of coal, but I think the cost is compensated by increased patronage to a certain extent. As to the difference in cost, it is too trifling for me to consider, as I have a surplus amount of current in the winter time on account of having a plant a little larger than I need in winter in order to meet the requirements of the heavy summer traffic from excursions.

I feel that when an electric railway uses coal stoves they should be classed with railways operated with horses. You can place me on the list of railways that use car heaters, regardless of cost for the elegant results obtained.

Yours truly,

W. WORTH BEAN.

THE CLEVELAND CITY RAILWAY COMPANY,

CLEVELAND, O., November 8, 1895.

I am in receipt of your favor of November 7, asking our opinion of electrical heaters for street cars. We have heated all of our motor cars by electricity for the past two winters. I have not the accurate data at hand giving the difference in cost of the additional expense of electric heaters over stoves for heating street cars. We all concede that the former is the most expensive in the daily operation, but the additional benefits to be derived from it, I think, are largely in excess of the additional cost. The room saved in car space, together with the much pleasanter and more healthy air, are much in favor of electric heating. It is much more handy mornings and evenings to turn on your heaters for several hours and cut them off in the middle of the day, when they are not needed. They do not mutilate a car and, I think, are very desirable.

Very truly yours,

J. B. HANNA, Sec'y. and Treas.

AURORA STREET RAILWAY COMPANY,

AURORA, Ill., November 9, 1895.

Replying to yours of the 7th inst., making inquiry concerning our experience with electric heaters for street cars, I have to say that last season we equipped one car experimentally and this season have furnished ten more cars with electric heaters. Concerning the reasons we had for adopting this method of heating our cars, I will state that although there has been no question but that the electric heaters were more expensive to operate than the coal stoves, yet the advantages secured by their use seem to us to sufficiently make up for the difference in cost. Cleanliness of the cars; close regulation of the heat; better atmosphere in the car; saving of seat space; freedom from the common accident of burning or charring roof and head linings of cars by overheated stovepipes; saving the labor in "coaling up", and last, but not least, freedom from the danger of fire in the car-house at night when cars are stored.

We use under our boilers, Illinois Screenings, costing us $1.00 per ton delivered, and hard coal costs $6.50 per ton here. With sufficient boiler, engine and dynamo capacity, you will see that the item of increased cost of heating by electricity is not so important in our case.

As regards the increased patronage by reason of electric heating, I am of the opinion that there is little in this point. I doubt if the public will increase their patronage of the cars to any appreciable extent, although they are pleased with the idea of a car heated in this manner, and will of course appreciate a car that is cleanly and comfortable.

Trusting that I have sufficiently answered your inquiries, I remain

Yours truly,

D. A. BELDEN, General Manager.

In addition to the foregoing it may be noted that the West End Street Railway Company, of Boston, is equipping its cars for electric heating, having recently placed an order for eight hundred heaters with the American Electric Heating Corporation. This action of course entails considerable expense, and was taken only after the efficiency of electricity for the purpose had been demonstrated beyond question. Boston enjoys some pretty cold weather in winter, and if electric heating proves satisfactory there, there is hardly any part of the country where it will not meet the most exacting requirements. The West End Street Railway Company is under management which looks very closely after the interests of its shareholders, and it is altogether unlikely that this new form of heating would have been adopted had there not been the best of reasons for doing so. The time probably is not far distant when heating by any other means than the electric current will be relegated to the past as the horse-car has been.

The telephone clerk dismissed for inefficiency, found that he had missed his calling.—*Tammany Times.*

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HOW A STREET CAR IS WIRED.

Course of Current from the Trolley Wire to the Ground Connection, Providing En Route, Power, Light and Heat—Devices for Control and Safety.

THE CURRENT UNDER COMPLETE CONTROL.

A passenger on an electrically propelled car, unless he happens to be an electrician, has very little idea of the maze of wiring and the intricacy of the switches necessary for the complete control of the current used on a car, says the Scientific American. The current, which is taken from the trolley wire above by the mere touch of the trolley wheel, and is delivered to the track, which, in connection with the ground and return wire, forms a return circuit, must be able to develop as much as 50 horse-power for starting the car, for grades, for overcoming obstructions, and for towing a trailer or a disabled motor car, and it must also be controllable to any extent so as to produce any desired power from the fraction of a horse power up to the full capacity of the motor or motors. In addition to this the current is utilized for lighting and heating the car.

To cause the car to stop or start, to go forward or backward, slow or fast, and to permit of operating it from either end, there is placed on each platform a box known as the "controller," having two hand levers at the top, one for reversing the motor, the other for varying its speed and stopping. The controller contains insulated contact springs forming the terminals of the various wires, and also a cylinder carrying a number of metallic segments for forming the various connections of the wires by contact with the different springs.

Fig. 1 is a longitudinal section of a trolley car, showing a motor connected with each axle, the controllers on the platforms, the electric heaters under the seats, the incandescent lamps under the roof of the car, and the trolley pole with its trolley wheel held in contact with the trolley wire by the pressure of the springs on the turntable on the top of the car at the lower end of of the pole.

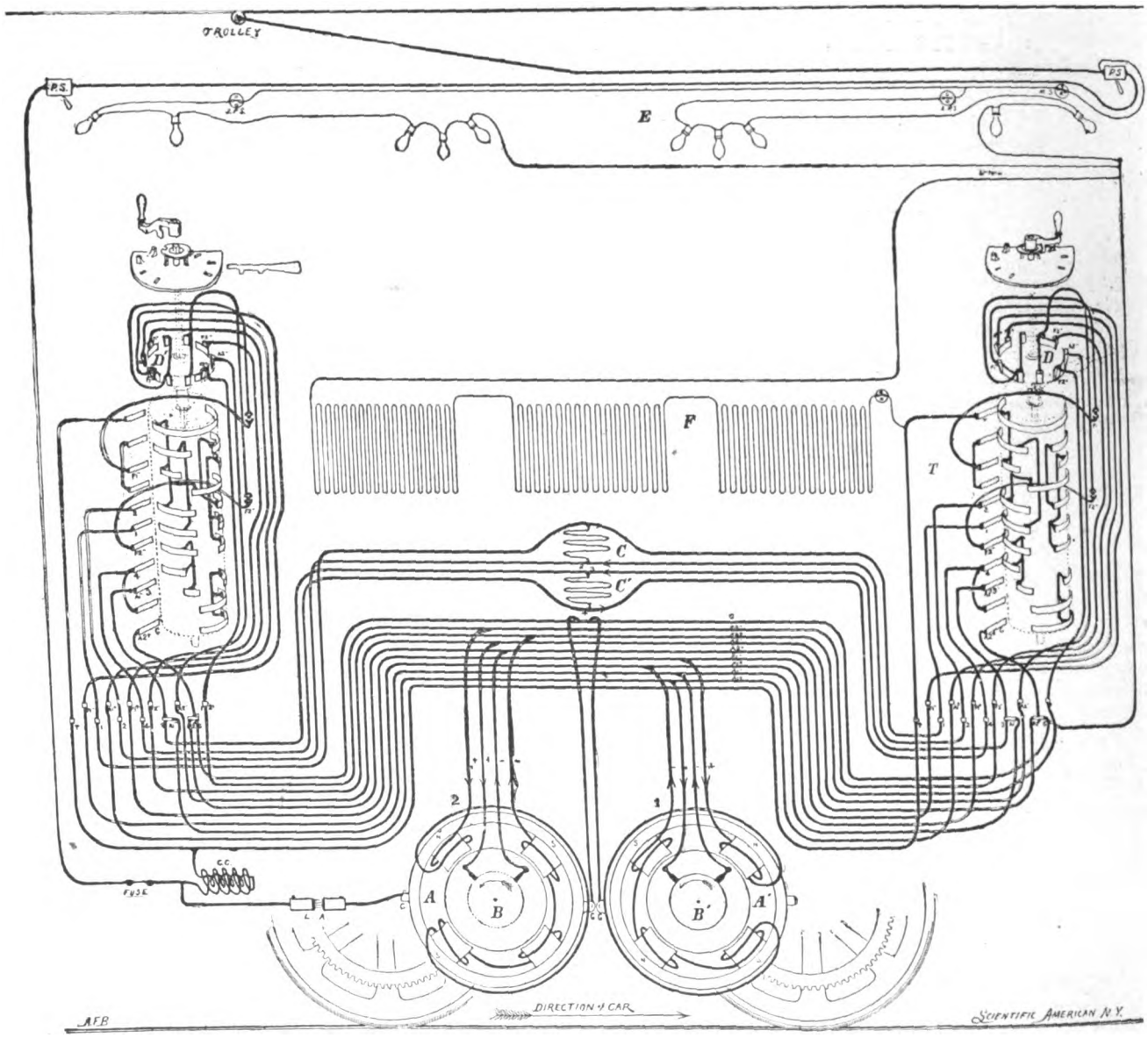

DIAGRAM OF THE ELECTRICAL CONNECTIONS OF A TROLLEY CAR.

The connections, as shown in the diagram, Fig. 2, (which represents the wiring of a car), are arranged for starting the car, *i. e.* with all the windings of the field magnets in series with the two armatures and the two resistances, *C*, C^1. These connections can be traced by starting at the power switch, *P. S.* Between the power switch and the motors are located the fuse and the choke coil, *c c*, which latter is designed to impede a lightning discharge so as to cause the lightning to pass to the ground through the lightning arrester, *L A*, ground connection, *G*, motor box, car wheels and truck, rather than through the motors.

The current passes to the wire, *T*, which is open at the rear controller, but which in the front controller touches the upper segment which communicates through wire 2 with resistance

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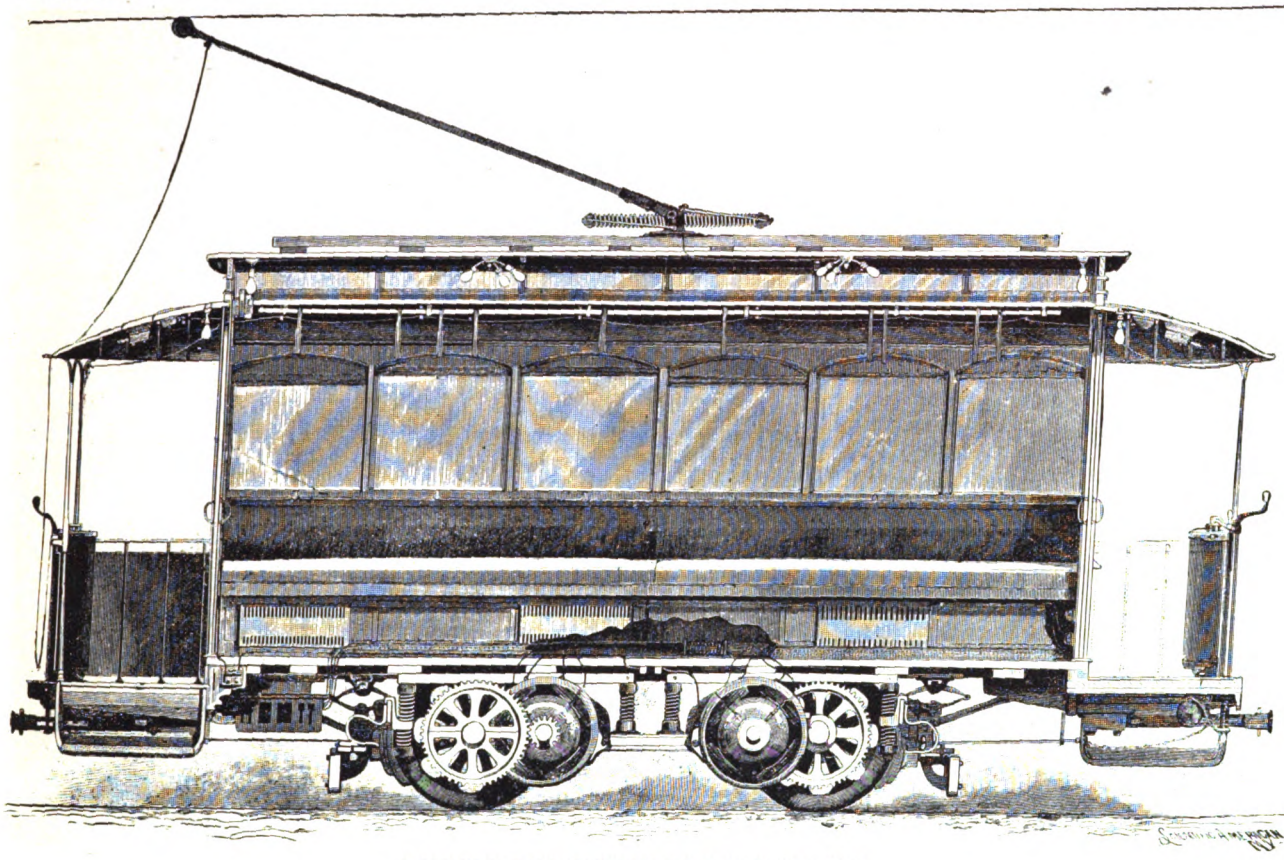
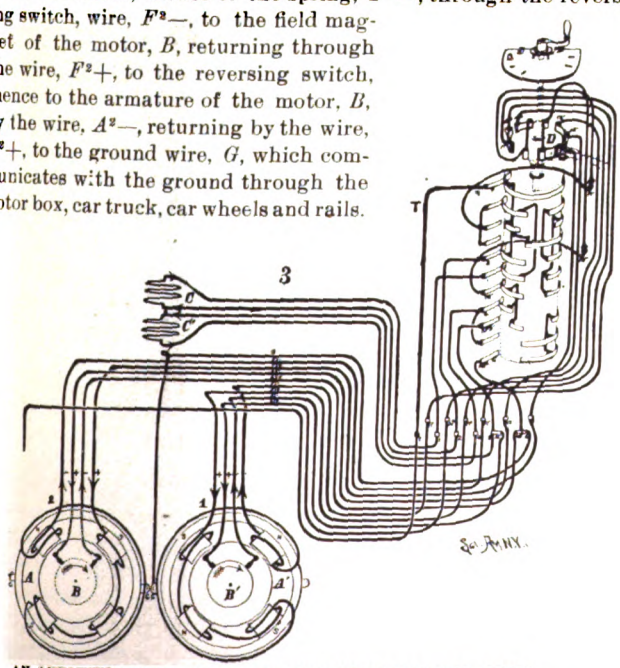
C, thence through wire 1 and the segment with one of the contacts in the reversing switch, D. The current flows thence to the field magnet of the motor, B', through the wire, $F'-$, and motor, A'; thence back to the switch D, thence by the wire, $A'+$, to the armature B', of the motor, A'. thence to the resistance C', to spring, 4, through the segment of the controller to spring,



LONGITUDINAL SECTION OF A TROLLEY CAR.

returns to the reversing switch through the wire, F^1+, thence through the wire, $A'+$, to the armature of the motor, B', through the wire $A'-$, to the resistance, C', thence back to the spring, 4, of the controller, thence to the spring, F^2-, through the reversing switch, wire, F^2-, to the field magnet of the motor, B, returning through the wire, F^2+, to the reversing switch, thence to the armature of the motor, B, by the wire, A^2-, returning by the wire, A^2+, to the ground wire, G, which communicates with the ground through the motor box, car truck, car wheels and rails.

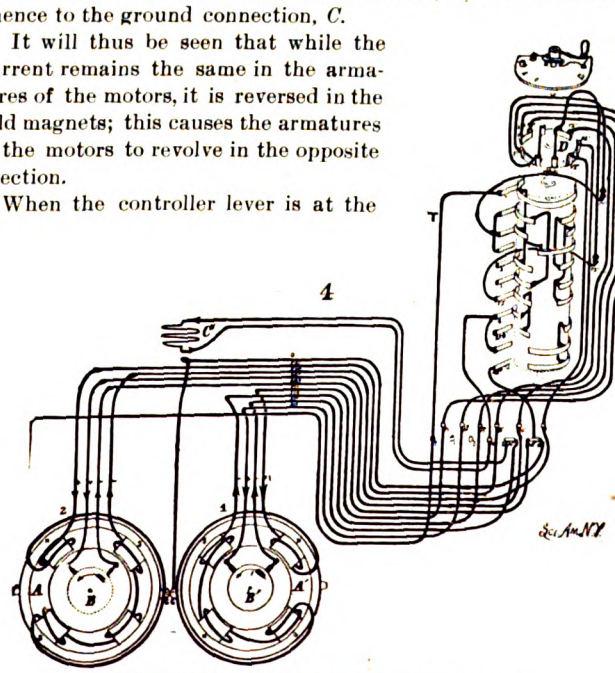


AN ARRANGEMENT OF THE CIRCUIT FOR REVERSING THE MOTOR.

Fig 3 shows the arrangement of the controller and reversing switch when the motors are reversed. The current enters the trolley connection, T, as before, passing to spring, 2, thence to the resistance, C, spring, 1, to the wire, $F'-$, thence to the reversing switch, D, and wire, F^2+, to the field magnet of the F^2-, thence by the wire, F^2-, to the reversing switch, D thence by the wire, F^2+, to the field magnet of motor, A, thence to the switch, D, and back to the armature, B, of the motor A, thence to the ground connection, C.

It will thus be seen that while the current remains the same in the armatures of the motors, it is reversed in the field magnets; this causes the armatures of the motors to revolve in the opposite direction.

When the controller lever is at the



THE CIRCUIT WITH ONE-HALF OF THE RESISTANCE CUT OFF.

first notch the current is fully on, with both the field magnets, armatures and resistances in series, as shown in Fig. 1. When it is at the second notch the resistance, C, is cut out, as shown in Fig. 4. With the controller lever at the third notch both resistances, C C, are cut out as in Fig, 5. At the fourth notch

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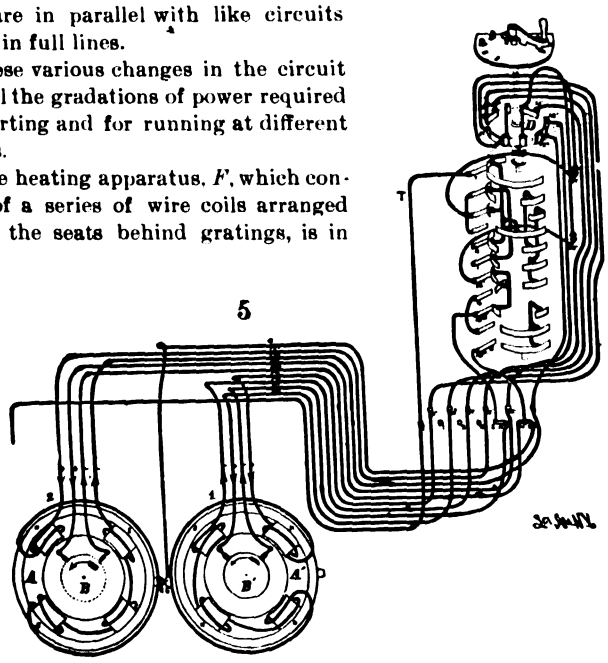
the motors are in parallel with each other and in series with the resistance (Fig. 6).

When the controller is arranged as shown in Fig. 7, the two motors are in parallel and in series with half the resistance. When the controller is arranged as in Fig. 8, both motors are in parallel, the resistances being cut out. Circuits shown in dotted lines are in parallel with like circuits shown in full lines.

These various changes in the circuit give all the gradations of power required for starting and for running at different speeds.

The heating apparatus, *F*, which consists of a series of wire coils arranged under the seats behind gratings, is in parallel with the electric lighting apparatus and the motors. Enough current is taken from the supply wire to maintain a comfortable temperature in the car. There are two lamp circuits on the car, each including five 100 volt lamps, the lamps of each set being in series.

At suitable intervals on the various branches of the road there are telephone boxes, by means of which the engineer or electrician at the power station can be notified of anything occurring on the lines, and by which the dispatcher is informed whenever an emergency arises calling for more than the usual number of cars.



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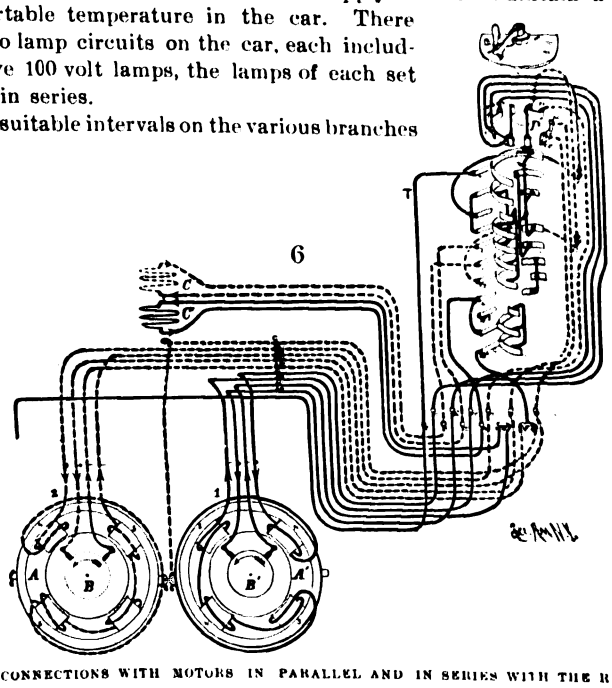
THE CIRCUIT WITH ALL THE RESISTANCE CUT OUT.



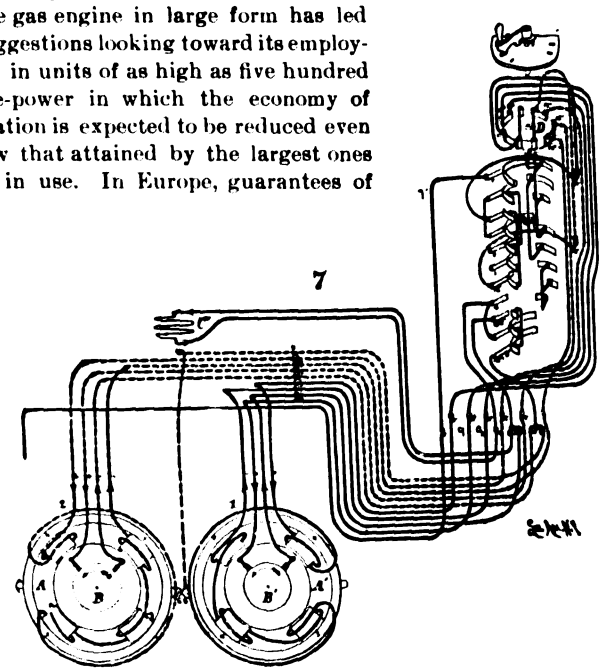
6

THE CONNECTIONS WITH MOTORS IN PARALLEL AND IN SERIES WITH THE RESISTANCE.

"Oh, hello Central!" he doth cry,
Until, with fire flashing eye
And with one wild wail of woe,
He breaks forth into language high
By leaving off the "lo."—*New York Journal.*

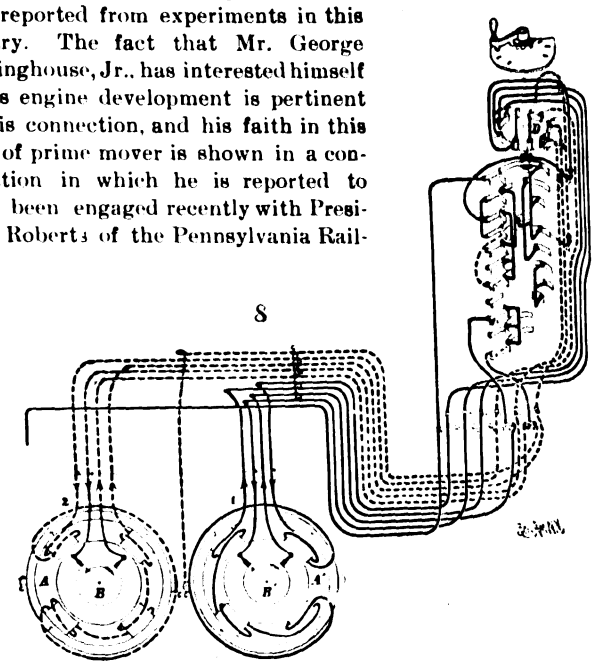
THE GAS ENGINE.

The gas engine is beginning to attract its proper share of attention from mechanical engineers and there are evidences that this form of power producer may possibly play an important role in the development of electric traction, especially where applied to existing steam lines, says the Railway Review. The success of the gas engine in large form has led to suggestions looking toward its employment in units of as high as five hundred horse-power in which the economy of operation is expected to be reduced even below that attained by the largest ones now in use. In Europe, guarantees of one horse-power from three-quarters of a pound of coal are being given by builders, and it is predicted that better results are soon to be reported from experiments in this country. The fact that Mr. George Westinghouse, Jr., has interested himself in gas engine development is pertinent in this connection, and his faith in this form of prime mover is shown in a conversation in which he is reported to have been engaged recently with President Roberts of the Pennsylvania Railroad. Mr. Westinghouse is quoted as saying: "The Pennsylvania Railroad to-day, it is said, consumes about 5,000,000 tons of coal per annum on its lines east of Pittsburg, taking approximately twenty loaded trains each day for the transportation and consequently the return of 20 empty trains and requiring for the service of the company alone 3,000 cars and a proportionate number of locomotives. If this power was to be generated by gas engines, only about one-eighth or 600,000 tons of coal per year would be required, effecting a saving of over 4,000,000 tons of coal, now costing the railway company about $5,000,0 0, a saving which would justify a large enough capital expenditure to cover the complete equipment of the railway." There is no doubt of the



7

BOTH MOTORS IN PARALLEL AND IN SERIES WITH HALF THE RESISTANCE.



8

MOTORS IN PARALLEL WITH ALL THE RESISTANCE CUT OUT.

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TRIBUTE TO FRANKLIN L. POPE.

There are individuals in this world, who have that personal magnetism about them which draws us to them, even though we may be far distant, for whom we conceive a kindly feeling even though strangers. There is an unexplained liking which perhaps comes from reading, probably from hearing through others of the good points in their mental make-up. In something this way I was first drawn to "Frank L. Pope," as his name appears in his "Modern Practice of the Electric Telegraph," published in 1869. That book endeared him to me before I had ever met him. The plain, honest, every-day way in which the statements are made, are typical of the straight forward electrician whom we all mourn to-day.

Subsequent acquaintance with Mr. Pope strengthened the respect and brotherly feeling which had its birth in the reading of the "Modern Practice." We were very little together. He mostly at the East, and I at the West, met but seldom—but there was always a delight in reading his writing, and an unconscious leaning to his side of the argument in all published controversies.

In 1878 it was my pleasure on several occasions to meet him in Paris, where we had both gone to attend the Exposition. Beneath the quiet, unassuming gentleman there occasionally beamed a ray of genial humor. In the French Telegraph Department, one day with Hughes, the latter was explaining to Pope and the writer some improvements in the instrument, when an officious little operator stepped up to show us the working of the Hughes Printer. Among other things he explained that the key board was so arranged that many sentences could be written by running the keys much as one would run a scale on the piano. The advantages of this arrangement was the saving of time, and to illustrate this he spun off with considerable rapidity a tough sentence of four or five words, then arose from his seat with an air of importance very satisfactory to himself as if to say, "That's the way we do in France."

Mr. Pope happened to be a first-class Hughes operator, and it had been the pride of the American operators to search for that class of sentences, and to the great astonishment of the French operator, he rattled off a sentence which had been the pet of the fraternity at the Continental, which, as I remember it, was "Is'nt it hot in the Continental Hotel?" The bluffer was bluffed, and as he turned away remarked something not overly complimentary about the Yankee who never said he was an operator.

During the Exposition the French Government ordained several fete days, one of which was the anniversary of the fall of the Bastile, when the theatres were free, and the city was illuminated. Every public building in Paris had in stock a complete trimming, if I may use the word, of cornice, dome and corner, of gas pipe, pierced with small burners. These pieces are numbered to match, so that in a day, every border line of a building, every window sash or other marked architectural division can be connected to the gas mains, and at a signal a single match lights the whole.

Knowing more about this fete business than most of us, Mr. Pope made a proposition on one such occasion, that we should form a club and put ourselves under the protection of one of Cook's English-speaking guides, and give him *carte blanche* to show us the sights. He took us to the Bois de Boulogne. The beautiful lakes were ablaze with fireworks, and as we entered the grounds there burst suddenly upon our view the forest, every tree of which was thickly hung with orange-colored Chinese lanters. Amidst the "Ah's" and "Ohs!" of the party Frank broke out with "Who but a Frenchman would ever think of raising pumpkins on apple trees."

The laugh that greeted this sally showed that there were other English-speaking people in the crowd besides ourselves; a fact that was still further evinced, when, as we left the grounds some one started "Auld Lang Syne." At least a thousand voices, I think, joined in the chorus.

Mr. Pope's unfortunate taking off is an irreparable loss to the Electrical fraternity. As a scientist he was earnest, thorough and conscientious, as a man honest and upright, as a friend warm-hearted and true. Of him it may be said by any of us in the language of the poet:

"Green be the turf above thee,
Friend of my better days;
None knew thee but to love thee,
Nor named thee but to praise."

C. C. HASKINS.

DECIDES AGAINST BELL.

Chief Justice Fuller has handed down the opinion of the United States Supreme Court on the motion of the Bell Telephone Company to dismiss the suit of the United States against that company and Emile Berliner, involving the invention of the speaking microphone. This is the case appealed from the circuit court of appeals of the first district.

The United States brought suit for the annulment of the Berliner patent some years ago, alleging fraud in its issue. After many delays the suit was decided in the summer of 1894 by Judge Carpenter of the United States Circuit Court, of Boston, in favor of the United States. An appeal was immediately takento the United States Circuit Court of Appeals. Last summer that court reversed the decision of Judge Carpenter and re-established the Bell in its old position. Under the law, a decision of the United States Circuit Court of Appeals in patent litigation is final, unless constitutional questions are involved, when the United States Supreme Court may be resorted to. The court of its own motion may, however, certify the case up, or the Supreme Court may send for it.

Preparations to get the cause before the final tribunal were begun by the government immediately upon the rendition of the decision of the United States Circuit Court of Appeals. The case will now have its final hearing before the Supreme Court.

PARIS EXPOSITION OF 1900.

Our Parisian friends have already gone into the details of the electrical installation of the Exposition of 1900. According to L'Electricien all except the veriest details have been arranged. Naturally enough the Columbian Exposition is taken as a basis of all the operations, only our mistakes are not to be repeated. The French administration is not anxious to assume the Herculean task of creating the installation, and so exhibitors of electrical apparatus will be given space in the Machinery and Electrical buildings for their machines. The apparatus will be furnished without charge by exhibitors. The management will create the initial power only to move the electrical machines, and will reserve the right to charge private exhibitors for special lighting. The electrical apparatus will remain in charge of the owners, who will be given certain work to do in the shape of lighting and power, the exposition management simply reserving a general control to the extent of compelling an efficient service.

Arrangements to date provide for 20,000 horse-power, of which 15,000 are for lighting, and the remaining 5,000 for the operation of motors for the running of general machinery and the exhibits. There are to be 65,652 incandescent lamps and 6,585 arc lamps. All conductors will be laid under-ground.

HELLO.

"Talk is cheap," observed the man who believes in proverbs. "Humph!" replied the man who doesn't; "that remark shows that you never employed a lawyer or rented a telephone."—*Augusta Chronicle.*

In New York there is a law making it a crime for telephone girls to divulge what they hear over the wire. This wouldn't be so bad if people could more easily tell what the party at the other end says.—*Philadelphia Times.*

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

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THE GAS ENGINE.

[*Continued from page 232.*]

justification if the proposition mentioned can be proven, which seems probable, and the gas engine would seem to offer a means for subdividing the power for an electric line into satisfactorily small units. The gas engine has a strong claim upon the attention of those who are soon to be driven to compete with present trolley lines. It is known to be one of the ideas of Mr. Westinghouse, in connection with the electric operation of present steam lines, to establish stations with electric generating plants driven by gas engines, together with the gas producers located at intervals of from ten to twelve miles, so that there will always be two or three stations furnishing current for any given point upon the line. The trains would then be subdivided so that no electric locomotive would need to have more power than that required to haul from twenty-five to thirty cars. The subdivision of power would be easy and economical if the gas engine can be advantageously used in units of about five hundred horse-power, but the great difficulty will be in rearranging the method of operating roads which such an equipment would necessitate. The behavior of large gas engines will be watched with considerable interest and if present indications are fulfilled by practice they may have a very important part in the transportation of the future.

AMERICA IN FOREIGN MARKETS.

There can be no question of the fact that the lower cost of material and the lower cost of production are stimulating the export of American electrical apparatus, while the manufacturers appear well satisfied with the prices they get. In China and Japan, arc and incandescent lighting plants from this country are popular, and now our electric railway machinery is making a name in the East. One of the latest developments has been the demand for American electric mining apparatus in Mexico, Central America, and the Cape of Good Hope, while the superiority thus shown has in turn made a market for other goods. A curious example of this has been given at Buluwayo, a swarming kraal that barely two years ago bowed to the rule of the warlike Cing Lobengula. To-day a thriving modern city has sprung up with a rapidity that makes the growth of Western mining camps seem slow, and one of the first necessities has been a lighting plant. In open competition with the world, and solely on the strength of its blue prints and its reputation, an American company has carried off the contract, and now apparatus that was built in the Valley of the Mohawk River is brightly illuminating the new home of civilization in Southern Africa, and advertising nightly by its excellence the skill and enterprise of the United States. Hitherto the field has been a European appendage, but under the new tariff South Africa is rapidly becoming an American commercial centre. It is worthy of note that in this plant, not only the dynamos and lamps, but the boilers and engines, are all of American make.

THE FENDER PROBLEM.

The municipal authorities of a large city, who recently ordered the local street railway companies to provide their electric cars with an effective fender by a specified date, may be fairly supposed to have had an imperfect understanding of the conditions governing the provisions they sought to bring about. It is another confirmation of the rule that important inventions are gradually developed, and do not come ready made from the brain of the inventor, that the street car fender should still be unperfected. The modern locomotive, for instance, is the result of an infinite number of modifications of the original idea. There are over 1,000 forms of car guards, and the outlay in experiments during the last year has been almost incredible. A remarkable feature in this activity is the heterogenity of the people who have sent in designs which they confidently hoped would settle the difficulty. Not only street car men of all branches and ages, but mechanics of all grades, lawyers, doctors of medicine, ministers, and women of fashion have taken part in the competition, and in hardly one case in a hundred has the designer appeared to have the remotest idea of the essential difficulties of the problem. As might be expected, the spirit of rivalry among the fender men has been keen. It reached its climax in Montreal, where one inventor had his son prostrate himself on the track again and again, and send the car toward him at a speed of twelve miles an hour. The car equipped with this fender was taken to different parts of the city and run on the same time with the other street cars. No notice was given of the place of test. As the car approached at regular speed, the inventor's son ran from the sidewalk and dropped down on the track, his head on the rail, and his feet on the other. Men shouted and women screamed. The "trip," or wire apron, struck the prostrate form and the fender fell. The car came to a dead stop in a small cloud of dust, out of which the young man crawled with a smile on his face. He said he had made the trial with thin clothing as well as thick, and he had no fears. The inventor said this experiment had been tried with the car going at the rate of twenty miles an hour, and has never failed. However much this fender may show an improvement on the ordinary forms, its sensational test has not convinced the railway people that it meets all their needs. Until the perfect car fender has been evolved, the public safety will have to depend upon improved brakes, and cautious and skilful motormen. On the Lynn and Boston Railroad, which claims that on its lines no injury has yet been done to life or limb, this immunity is said to have been mainly owing to the exercise of an extreme carefulness by the motormen.—*New York Times.*

THE HORSELESS-CARRIAGE FACE.

The horseless carriage, used for pleasure purposes, is to be seen at times in the upper part of the city. A stylish one, in which two wide-awake riders were seated, made good time through several of the busy streets there the other day. It was on Columbus avenue. The rider at the helm was skilfull under difficulties. He had to be on the alert every moment, as he guided the carriage amid the flying cable cars, the wagons and other vehicles, the bicyclers and the pedestrians with which the avenue was crowded. He succeeded in keeping the thing clear of the dangers that environed it, and in preventing it from jolting against other people. After a while the helmsman's anxiety became visible. His features were raveled; his expression turned to that of a terrified savage; he glared. His face was ten times more aggravating than the bicycle face; it was of a kind that might be called the horseless-carriage face, or, for short, the horseless face. We must hope that such a face will not take possession of all those people who may hereafter use the horseless carriage when bent on pleasure. We protest against the face and against the introduction of it. Better have droves of horses on every block in the city all day than even one specimen of that face to the block. If a woman were to make her appearance on Broadway in a horseless carriage publicly displaying a facial expression like that of the engineer of the horseless carriage upon Columbus avenue recently, people would surely dart into the side streets.

We have seen but one horseless face. We do not want ever to see another.—*New York Sun.*

The story of how lightning conductors came to be adopted in the British navy is interesting. In 1866 C. Tomlinson, a Fellow of the Royal Society, described in England a method of receiving the discharge of a Leyden jar on a plate of crown glass. He showed on the glass tree-like figures, with trunk, branches and spray, and argued that this was only a miniature representation of the lightning ash, which was similarly bifurcated and even trifurcated. At that time lightning conductors were not in favor, either on land or sea. Dr. Dyne, the head-master of the Highgate public school, who consulted Tomlinson as to the desirability of a lightning conductor for the new school building, said he had never seen one, and had only a vague idea of it; furthermore, although he personally was open to conviction as to its merits, his profession looked upon the conductor as attracting lightning in place of repelling it.—*San Francisco Bulletin.*

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DR. FRANKLIN'S INVENTIONS.

It is remarkable that there is not in existence a biography of Benjamin Franklin which gives a complete account of the inventions and scientific discoveries made by the versatile genius who is rightly called "the brains of the American Revolution." Great as was Franklin as a diplomat and statesman, he was greater as a scientist in the domain of physics, wherein he planted seeds which bore fruit in his own time, and again in our generation.

His pet study, electricity, which in the eighteenth century was a diversion of schoolmen, has become a gigantic industry, affording employment for nearly 2,000,000 persons in the civilized parts of the earth. To Franklin are we indebted for many things which remained fallow in the science of electricity, until Davy, Faraday, Edison, Brush, Thomson and Tesla began to pick up the threads which Franklin left in the bloom of life, when he was summoned from earth. Within two years an expensive litigation between two joint stock companies concerming the right to use a certain submarine electric machine for blowing up ledges and sunken wrecks was brought to an end when evidence was introduced showing that Franklin used similar apparatus in the Delaware river in 1787. Many of his inventions have been patented over and over again in our Patent Office, where articles in daily use by the cave dwellers may be patented by any person foolish enough to consider a United States patent of any value, and who does not know that the 400 patents taken out by Edison have been "pirated" under the protection of the United States laws, which are apparently made for the profit of infringers of patents and for the bankrupting of inventors. Franklin's electrical inventions numbered eighteen, all made when his intellectual faculties were brightest.—*Boston Pilot.*

ELECTRICIANS' WORTHY OBJECTS.

The electrical workers who have been holding their convention in Washington during the past few days have a very good set of objects in view; objects which everybody will hope they may speedily attain. Among others ennumerated are:

To rescue the trade from the lower level to which it had fallen previous to the formation of the organization, and by mutual effort to place themselves on a foundation sufficiently strong to prevent further encroachments. The members propose to establish an apprentice system, to maintain a higher standard of skill, to encourage the formation of schools of instruction in labor unions, for teaching the practical application of electricity and for trade education generally, to cultivate feelings of friendship among the men of the craft, to settle all disputes between employers and employes by arbitration, to assist each other in sickness and distress, to secure employment, to reduce the hours of daily labor, to secure adequate pay for their work and by legal and proper means to elevate the moral, intellectual and social condition of all the members."

It has ever been the aim of the executive officers of the Brotherhood to adhere strictly to the principles above enumerated and as a result the members have had very little trouble with their employers and in nearly all cases the matter under dispute was settled by arbitration to the satisfaction of all parties concerned.

During the few years of its existence the Brotherhood has paid out thousands of dollars to sick and needy members, besides paying a large amount to the orphans and widows of deceased members, and is to-day in a flourishing condition.

From a small beginning the National Brotherhood of Electrical Workers has passed many of the older organizations and the growth seems almost phenomenal, and the organization extends from the Atlantic to the Pacific, and from the Gulf of Mexico to the Canadian border, with local unions in all the principal cities.

The members of the Brotherhood feel justly proud of the work they have accomplished. In a number of cities the hours of work have been reduced from ten to eight, and wages have been increased from 10 to 50 per cent. As it is the duty of each member to assist a brother member, and to explain all difficult points to him, the organization is one vast school, where all are scholars and teachers in turn, and, as a result, the work done has been much better and given more satisfaction, both to the employers and the public. A few years ago each workman was jealous of the other, and, instead of assisting one another, they would invariably work against each other, no one caring how the work was done, and each blaming the other when anything went wrong, which was an every-day occurrence. Since 1891 there have been but few difficulties with employers, and, as above stated, they were settled satisfactorily to all concerned.—*Washington Post.*

THE OFFICE OF CITY ELECTRICIAN.

The city electrician is coming to be a very important functionary in a good many American municipalities, and the tendency to load upon him a variety of new and unrelated duties is viewed in electrical circles with some concern, as the whole drift in modern electricity is necessarily towards specialization. The office owes its creation usually to the existence of a city fire-alarm bureau or a police telegraph system. The movement in favor of underground wires has in many places added the supervision of a subway system; and latterly the control of all the interior wiring has been intrusted to the same official, as in Pittsburg and Philadelphia. Meanwhile, about 200 communities of all sizes have established municipal electric-light plants, and, where possible, these are directed by the same city electrician, as in Chicago. In one or two states there is an agitation afoot for municipal telephone exchanges, and the overloaded official now has to deal with the problems of the intricate telephone art. Not only this, but in Detroit the electrical engineer of the city Lighting Commission has had to take the unruly and superabundant shade trees in hand; while in the same city the spirit of Pingreeism has now gone so far as to demand the municipalization of the trolley-car tracks. Just where this will all end no electrician can well foresee; but it is already obvious to the professors of electrical engineering in American colleges that their courses cannot be too comprehensive. There is a marked improvement in the personnel employed in this class of work, which once fell generally to a smart telegraph operator with a political pull; but now, in regions as far apart as Massachusetts and Minnesota, it is allotted to experts, often college bred, who have not merely practised the art, but are familiar with its theory.—*New York Times.*

ELECTRICITY AND POLITICS.

Everybody seems to think it is necessary to discover some reason beyond the obvious for the overwhelming triumph of the Republican Party in the recent elections.

If any other than the obvious reason is necessary—why not consider the effect of the increasing production of electricity?

At the last meeting of the Electro-Therapeutic Society it was plain that the doctors who place their trust in electricity place no limit to its curative powers. It was asserted with the utmost gravity that stupidity may be cured by this still mysterious agent. There was one case which served as a type—a chuckle-headed boy who could not add three to three, became a mathematical prodigy after thirty electrical treatments. Many other instances of vastly improved intellect following the application of electricity were formally reported.

In the past three years the use of electricity has extended enormously. The general result is that there is more electricity in the air than ever before. From center to circumference the country is filled with the prickly, sputtering, flashing, shocking element. If the electro-therapeutists are right, this must have a tremendous influence on the intellect of the people. There is not only less rheumatism, but also less stupidity and therefore fewer Democratic votes. By stimulating the mental processes of mankind, electricity has cured thousands of their Democracy.—*New York Sun.*

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THE ELECTRICAL JOURNAL

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

VOL. I. CHICAGO, NOVEMBER 15, 1895. NO. 12.

The Motor Vehicle Contest.

At the last moment, the Chicago Times-Herald Motor Vehicle Contest was postponed to November 28—Thanksgiving Day. This action was taken by the judges in obedience to urgent requests from prospective contestants, and representations made by them that they could not complete their vehicles in time for the prearranged date, November 2.

On Friday evening November 1, there were six vehicles ready. There were at the same time more than twenty letters and telegrams from those whose vehicles had been entered protesting that the time in which they were obliged to get ready had been too short, and asking for an extension. For the first time since the judges were appointed, Mr. Kohlsaat was sent for and a long conference was held, during which the contestants already on the ground were called into consultation. It was unanimously agreed that if the contest was to decide anything at all, it would be the relative merits of a full representation of the varieties of motor vehicles before the public. Since there was not present such a representation, the very purpose of the contest would be defeated in the event of its being precipitated. There was, moreover, abundant precedent for a postponement, the first Paris contest having been postponed twice, and the last one once. The judges therefore declared the present contest postponed to as late a day as was possible with a fair assurance of good weather. Mr. Kohlsaat insisted on a demonstration for the benefit of the public, however, and generously offered to the judges an additional purse of five hundred dollars, to be employed in whatever way they might select. It was decided to divide the purse among those contestants who would go over the course irrespective of a time limit. Two vehicles started, both operating gasoline motors, one belonging to Mueller, of Decatur, Ill., (Benz Motor, of Manheim, Germany,) and one the property of the Duryea Manufacturing Company, of Springfield, Mass. The last named got into trouble, and the Mueller Machine was the only one to finish, the time being an average of ten miles an hour for the course of ninety-two miles.

The judges have met several times since the postponement, and have now definite promises enough to assure not less than a dozen starters on November 28, and it is more than likely that there will be twenty.

The judges have learned a good deal since their service began, and their newly found knowledge will be brought into play for the coming contest. Among other things they have found it expedient to change the route, selecting a course this time entirely within the limits of Chicago. One reason for this is the fact that the authorities of the city have shown a most cheerful desire to help all they can, and are willing to put the road in good repair wherever required, while no such favorable action could be hoped for outside the city. Another decision is that the scientific tests are to be made for the benefit of the judges only, and outsiders will not be permitted to be present. The results will be incorporated in the report of the judges, and will be published in the Times-Herald. The judges reserve absolutely the right to make the awards on their own judgment, without being handicapped by any conditions. They have adopted, however, the following points of merit, which will be given precedence in the order named:

1. General utility and adaptability.
2. Ease of control.
3. Speed.
4. Cost.
5. Economy of operation.
6. General appearance and excellence of design.

The judges have fixed arbitrary values for these points, but these values will not be published until after the contest.

Minor changes are made in the rules governing the contest, but as these are simply made because of the change in route, they will not be of sufficient interest to warrant their publication again.

The race will start on Thanksgiving morning at nine o'clock from the Midway and Jackson Park. The first "leg" of the course will be along the lake shore north over the Rush Street bridge, through Lincoln Park, etc., and ending at the starting point. A time limit of seven hours is fixed, the course being fifty-six miles. This does not mean that vehicles will be barred from the prize if they fail to score within that time, but that they will not be given any credit marks for speed.

It is a most happy thing that the contest was postponed, as the new conditions will give to it a far greater value than would have been possible under the initial conditions.

* * *

Our Little Controversy Ends.

Neither the electrical people nor the lay public is in any manner likely to be deceived by the sudden fit of virtuous indignation on the part of the publisher of the Western Electrician against Mr. J. P. Barrett, Chief of the Chicago Electrical Bureau and President of THE ELECTRICAL JOURNAL. Mr. Barrett has held the same office or an office in the same department of the City of Chicago, man and boy, for thirty-five years. The Western Electrician has been published by its present proprietor for more than ten years. Never, until June last, has the latter even indicated by word or sign any dissatisfaction with the conduct of the electrical affairs of Chicago. At that time the first number of THE ELECTRICAL JOURNAL was offered to the public. That date was coincident with Mr. Kreidler's spasm of alarm over Mr. Barrett's actions.

Repeatedly, and at intervals, Mr. Kreidler has announced that there was not room in the West for a second electrical periodical. His success in smothering the ephemeral flame of one or two attempts to launch an enterprise similar to his, has brought him to a full belief in his patent right on the whole western country, and now that he is likely to be undeceived his wrath is distressing.

We have, from time to time, essayed a little fun at the expense of our contemporary; but he is taking it altogether too seriously, and any further exchange of civilities with him is likely to become undignified, and would certainly grow tiresome, especially to our readers, for whose wishes and tastes we have a wholesome regard.

The animus of Mr. Kreidler's attack on Mr. Barrett is too apparent to justify argument, and we beg to announce that we

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do not purpose to take any further notice of it. We shall expend all our efforts hereafter to the presentation of the newest thought on Electrical subjects to our readers, and to the maturing and execution of our plans for reaching the largest number of possible buyers of the wares of our advertising patrons. If we shall meet with the fulfillment of our own ambitions in these directions, we shall be able to benefit the commercial and scientific electrical world, and shall at the same time compel our contemporary to set before his readers a better paper than he now does.

* * *

Electric Heating of Street Cars.

Elsewhere in this issue will be found a most timely discussion of the heating of street cars by electricity. Some time since the same topic was discussed in these columns, and the figures shown indicated an unsettled feeling among street railway men, and a question in their minds as to the availability of the electrical current for heating purposes. A number of tests were at that time under way. The approach of winter, and the rumored placing of a number of large orders for electrical heaters, has seemed to us a justification for a re-opening of the discussion.

There is no contention that the electric heater will compare in point of cost with the coal stove. A very short time ago the trolley car itself did not compare favorably as to cost with the faithful, but somewhat passe mule, but *tempora mutantur* and things are different now.

Some intelligent—even more than usually intelligent—street railway men are doing some thinking on their own account on this subject. They have—many of them—argued the matter from all its points of vision as it affects their own roads. Some of them for instance, are in competition with suburban steam roads, and while they can match the older method of transportation in point of number of stoppages and frequency of trains, they have not been able to do so in the matter of comfort to patrons. When they can do this a greater patronage will be theirs.

Again the safety is something to be taken into consideration. The cleanliness, both as to dirt and smell, and an account of importance, is the fact that on mild days and short runs for certain cars, the fuel is only being consumed during the actual running time, in the case of electricity. Taking this last fact into consideration, there is an open question whether electricity costs more than coal, but so far as we know, the only tests that have been made thus far show, not how much current is used for a given radiator in a given month or season, but how much current is used per hour of running time.

All things considered, electricity is not by any means to be counted out of the field of street car heating. We are not so wedded to our own idols that we could not afford to print the truth, and if any of the reasonings herein set forth are faulty, we shall be glad to set ourselves and our readers right, on due presentation of a satisfactory showing.

* * *

The Morse Telegraph.

We greatly fear that Brother Johnston's worthy efforts to throw light on the early history of the telegraph is in danger of shipwreck. We have been greatly interested in the series of articles in the Electrical World, and have watched the development of the story of the telegraph quite closely.

We think of course, with the large majority of readers, that any correct history will only serve to more decisively fix the credit of the great invention upon Professor Morse. We think also that Alfred Vail's place in history is firmly established under the effulgent glory of Morse's fame. For these reasons we had hoped that the World series of articles on this subject would come to a close without the belittling and narrow influence of Stephen Vail, who has done more to lessen the fame of his illustrious father, than his worst enemy might have done, by his unreasoning and absurd claims in behalf of Morse's highly valued assistant.

Posterity will do all possible honor to Morse, and also to Alfred Vail—the influence of the latter's son to the contrary notwithstanding. An interesting development of the Electrical World's enterprise is the contention of our British friends that they had a hand in the invention of the telegraph. And after all so they had—to the extent of honoring Morse—but that is all.

* * *

Electric Traction on the Erie Canal.

The State of New York has voted to spend a large sum of money in deepening the Erie Canal for the purpose of making it a greater waterway than ever before from Chicago and the West to the Atlantic seaboard. But the enormous outlay might well have been saved for some more pressing need, and probably would have been, had voting on the question been delayed until the advantages of the new system of electrical towage were fully understood. It is claimed on behalf of the new system that not only can the time occupied in transit be reduced one-half, but that the item of towage will show a saving of 85 per cent. as compared with present cost by horses or mules and 55 per cent. less than by steam propulsion. Where a vessel made one trip before it may hereafter make two, thus doubling the capacity of the canal. This, together with the reduced expense, would seem to obviate the necessity for any great outlay for deepening the canal at the present time. More than this; the canal is not running to anything like its present limit of capacity. The bare, uninviting facts are that New York is fast losing its prominence as a point of export for breadstuffs. Last years' shipments were something like eleven million bushels less than they were twenty years ago, while with the single exception of Philadelphia, all the other seaports show a substantial gain, and not even the deepening of the canal or cheap towage charges can give it back its old prestige.

* * *

Let Us Have Peace.

The development of the storage battery was delayed for years by litigation and its days are just brightening now, because the litigants are tired of the fight. This suggestion is apropos because of the pending court fight between the holders of elevated railway patents. It is not an easy thing to persuade elevated railway people to use electricity, and it will be utterly impossible if the ownership of the patents that must be employed are in doubt.

We do not wish to arbitrate the respective claims of the General Electric people and the Siemens-Halske Company, but merely to suggest that some sort of adjustment of these relations without hanging the whole matter up in the courts, would be to the great advantage of electrical interests, and especially electric railway interests.

* * *

Our French brethren who are preparing the electrical part of the exposition of 1900 are laboring under a mistake regarding the installation of the Chicago Exposition, which we think it desirable to contradict. The "grande etendue de l'Exposition" did not employ exclusively the direct current. On the contrary, all the incandescent lighting, to the extent of something over 100,000 16 c. p. lamps, was done by means of the alternating current, the mains carrying the current at 2,000 volts, to the entrance of each building, where it was converted by means of transformers down to 104 volts. The Lyons Exposition got its ideas from the practice at Chicago.

By reason of its close proximity to the great water power of Niagara Falls, Buffalo expects within the next thirty years to be the third largest city in the country in point of population and first in manufacturing interests. Buffalo evidently believes that in order to shoot high, it is a first requisite to aim high. So far so good, but it will be found necessary in addition, to elect Aldermen who are not so short-sighted as to stand in the way of opportunities for development, as they recently did in their dealings with the Niagara Falls Power Company.

Our good friend, Professor Forbes, has finally veered around to invective and accuses the typical American of being addicted to "bounce." He leaves us in doubt whether he means cherry

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bounce or the act of bouncing, but the state of the amiable Professor's feathers since he got home would seem to indicate the latter. However, the Professor "bounced" a little himself, in the former sense, while over here, if reports are worthy of credence, and we have only to fear that he got hold of what our Kentucky friends would call "fightin'" whiskey.

Buffalo allowed its centennial anniversary to pass three years ago unobserved. It is proposed now that the event be celebrated the same day that the electric current is turned on from Niagara Falls. In view of the disinclination of the Niagara Falls Power Company to accept the conditions imposed by Buffalo's City Council we are reminded of the famous receipt given by Mrs. Rorer for preparing a hare for the table, wherein she starts by saying "First catch your hare."

Brother Price, of the Electrical Review, has been on a hurried visit to the West, including Chicago, during the past week. The festive advertiser paid the freight. By the way, a new poet darkens the horizon in the person of Brother Price. Here is a child of his fancy, born at the Montreal Street Railway Convention:

"The street railway man who is the lord of creation,
Over city and suburbs has achieved 'domination.'"

We print the lines to insure them to posterity.

It is possible to please some people all the time and all of the people some of the time, but it isn't possible to please all of the people all the time. If then, while some people are clamoring to have overhead wires put under ground, some other people, and frequently the same people, are raising a hue and cry about tearing up the streets, the incongruity of the situation can best be accounted for by the relentless and uncompromising laws of fate.

The trolley is now king in Chicago. The City Council has just granted permission for the stringing of wires on Clark street through the most congested portion of the business district. The companies have for a long time been seeking the privilege, but public opinion presented a solid front in opposition; recently, however, there has been a change of sentiment and now that the barriers have been lowered it requires no stretch of imagination to see the whole business district a cobweb of wires.

The difference between the Armour Institute and the University of Chicago consists *partly* in the fact that the one spends most of its money in equipment, while the other spends its millions for men. In our humble judgment, men, if they are big enough, can dignify the most modest equipment, but little men make useless the grandest environment that a rich man's money can buy.

An eel that got into a water pipe at Stamford, Conn., the other night and thereby caused a "shut-down" of the electric light plant for two hours, would have been thoroughly impressed with his own importance if he could have strolled about the town during the darkness, and heard the comments on the occurrence.

Those who witnessed the attempts of the judges to bring about an instructive and conclusive horseless carriage contest, will agree that the absence of the horse does not necessarily bring about a corresponding absence of the jockey. The latter was in the saddle on horseless carriage day.

The London Electrical papers are deploring the degeneracy of the times in the matter of etiquette among electrical engineers. Did it ever occur to our English friends that example is a wonderful educator? And that literary piracy is not good precept to set before the rising generation?

A French physician has recently advocated the employment of a solution of picric acid for the burns due to contact with electric wires. There seems no good reason why the same remedy should not be good for other burns.

Electricity will eventually do more to suppress the crime of horsestealing than all the courts of justice in the land.

In Belleville, Pa., the township committee has refused to allow the use of electricity as a motive power for street railway purposes. Possibly the application was not made with a due regard to the preliminary details which usually pave the way for getting such privileges.

When Mr. P. B. Delaney gets into practical operation his system of supplementing the mails by the telegraph, his name will start on its triumphal march down the annals of time in close companionship with that of Sir Rowland Hill.

In order that there may be something for which everybody shall be grateful upon the national day of Thanksgiving, let somebody suggest a name to take the place of "motocycle."

An inventive genius has devised an electric annihilator for moths, flies and mosquitos. The New Jersey State right on such an appliance ought to be a fortune in itself.

The successful competitors in the motor vehicle contest on Thanksgiving day will at least have something substantial to be thankful for.

Kokomo, Ind., promises to go sailing down the seas of time alongside of Berliner, as a maelstrom of telephony. Ring off, Kokomo!

There is a horse on the judges of the horseless carriage contest, up to date.

CONTEMPORANEOUS COMMENT.

Electricity will kill. At least some of our esteemed contemporaries seem to have come to that conclusion since the sad death of Franklin Leonard Pope at Great Barrington, Mass., on October 13. If it were a poor lineman handling "hot stuff" every day for a mere pittance, instead of an electrical expert, his death would be ascribed to gross carelessness or heart disease.—*The Electrical Worker.*

Apropos of the discussion over the admitting of supply-men to membership in the American Street Railway Association, the Street Railway Review says: "All's well that ends well, but nevertheless one cannot consider without a feeling of mortification the fact that a body of men, representative of so gigantic interests as the street railway system of this country, spent so much time in coming to a settlement of differences which should have been accomplished in 30 minutes.

The secret of the great popularity of trolley parties, over which the elite of Philadelphia have become so highly enthusiastic, is now revealed. It is not so much in the pleasure of a delightfully fast, cool ride in the warm evenings, although this alone should be sufficient to make the fad deservedly popular, as it is "the tunnel." When, for any cause, accidental or otherwise, the trolley leaves the wire the lights of course are extinguished. And this causes "the tunnel." On every such occasion it becomes the prerogative of the young man to salute the young lady next to him with a trolley kiss. Just how a trolley kiss differs from any other we are not advised, but presume it is accompanied with a good deal of sparking. The imminent danger that the lights may be turned on at any instant, thus bringing the car out of the tunnel, only adds zest and excitement to the game. Now that the possibilities of the trolley party are fully known, we look for a big boom in this department of street-caring.—*Street Railway Review.*

PATENT DECISION.

The United States Supreme Court has rendered a decision declaring the Sawyer-Mann patents invalid. The decision grew out of a suit by the Consolidated Electric Light Company against the McKeesport Electric Light Company. It involved the claims of Sawyer and Mann and Thomas A. Edison to priority of application of the principle of incandescing carbon conductors made of fibrous or textile substances to electric lighting. The decision is an affirmation of those of the lower courts, but will not have any particular bearing upon public interests, inasmuch as the patents have expired.

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THE ELECTRIC FORGE.

Mr. George D. Burton has been in Chicago for several days installing a number of his electric forges. He reports that this substitute for the old time method is becoming quite popular and that the American Electric Forge Company of New York is having its hands full to take care of the business coming to it.

The forge consists of a box made of any nonconducting material. It is 30 in. long, 10 in. deep and 18 in. wide. It has a displacing plunger for raising the solution into contact with metal or other articles to be heated when a number of them are to be heated at one time. It is also provided with automatic contact electrodes connected to the negative pole which are swung into contact with the metal that is in contact with the liquid. Three smiths can work at the forge simultaneously, its heating capacity being ten times as quick as by a coal fire. The forge can get its current either from the trolley system or the ordinary arc or incandescent system. The number of amperes used depends entirely upon the size of the piece under test, the metal acting as a natural regulator entirely dispensing with a rheostat. A switch is not even a necessity excepting for safety in disconnecting the wires when the day's work is done. There is no consumption of current and therefore no expense excepting during the time that the piece is under heat and careful tests have been made to show that a saving over the ordinary forge of from 40 to 50 per cent. is made.

The principle of the forge and its operation is as follows: The positive terminal of the power circuit enters the box at one end and is attached to a lead plate of large area which is immersed in the solution, consisting of carbonate of soda, borax and alum which increases the gravity of the water to 1,025 at 84 Farenheit. The negative pole is connected to a box of metal about three-quarters of an inch in diameter, attached to the side of the box, the bar acting as a rest for the blacksmith's tongs holding the metal, or if the metal be of sufficient length, it can itself rest on this bar, then when brought in contact with the liquid, a voltaic arc is formed around that portion of the metal which is submerged, the arc being formed by the creation of hydrogen, which expels the oxygen and nitrogen, thus forming an envelope of gas around the piece, excluding the air therefrom, and making it impossible for any scale to form.

By this process copper and brass may be heated and welded without the use of fluxes. To weld copper by coal heat renders the ordinary forge fire useless thereafter for any other work, but by the electrical bath process, all kinds of metals are heated in the same solution and by the same current.

An interesting experiment was recently made in Rochester. Two horses (running mates) belonging to the Rochester fire department were shod at the same time, one with shoes made by the ordinary coal forge, the other made by the electric bath process. The latter proved to be the most durable by eleven days, representing a saving in that direction alone of forty-one per cent.

A further test showing the great heating capacity of the electric current and the insignificant cost of welding operations by that process was made some time ago in which it was demonstrated that a wrought iron railroad spike, showing a heating surface of one inch, and being one inch thick, becomes cherry red in fifty seconds, consuming twenty-six amperes of electricity with 220 volts. This indicates that there was required about 7½ horse power. Had this spike been subjected to the action of the bath an entire hour, it would have consumed about fifteen cents worth of power, but being heated in fifty seconds actually involved less than a quarter of a cent's worth of power, or to be exact 2½ mills.

Still another test was made with a screw bolt 1½ inches long and 1½ inch in diameter, which became neerly a white heat in 18 seconds, consuming 10 amperes, the voltage being the same as before, 220. This demonstrate d that a trifle less than three H. P. was required.

Send in your subscription to THE ELECTRICAL JOURNAL.

MRS. FANNIE M. MERRYFIELD.

In the several branches of the telegraph service throughout the country there are a few operators who, by an unusual degree of expertness in the receiving and sending of messages, have won special distinction among their co-workers, but even in that limited coterie there are few indeed who have a record that can equal that of the subject of this sketch; a record of which Mrs. Merryfield is not only justly proud herself, but which the Western Union Company is pleased to hold up as an example of what may be accomplished by intelligent and persistent application to duty. Mrs. Merryfield first entered the telegraph service in a small office at Blairstown, Iowa, in 1865, for the old Illinois & Mississippi Telegraph Company. In 1868 she went to Chicago as an operator, and later as chief of the ladies' department. In 1872 and 1873 she was an operator for the Atlantic & Pacific and Union Pacific at Omaha, under Mr. Dickey. From 1874 to 1876 she was in San Francisco and Los Angeles for the Western Union, and between 1878 and 1882 served in Colorado for the Western Union and Denver and Rio Grande Railway Company. In 1883 she went to Cheyenne, and has remained there up to the present time, occupying the position of night wire chief. In that office there are eight duplex and two quad sets, besides the Wheatstone repeaters, half-set, Morse repeaters, etc., all of which Mrs. Merryfield has in charge, giving the utmost satisfaction. During the recent Indian troubles in Wyoming her expert work called forth remarks of surprise from newspaper operators in Chicago and New York by her good sending. The Western Union management speak of Mrs. Merryfield in the highest terms, and express the hope that her thirty years service may be supplemented by many years yet of usefulness both to herself, to the company she serves so acceptably and to the public.

A new phase of luxury in domestic life is, it is said, now being inaugurated by the ever-increasing applications of the electric current. A wealthy manufacturer, says an exchange, who has just built a large country house, ordered provision made for using electricity for all the household purposes te which it can now be applied. How well the order was carried out can be guessed from the fact that the switchboard alone cost $3,000. Nearly all the manual work of the kitchen, the cleaning of knives, dishwashing, etc., all the cooking, and the heating of the house, are, of course, done by electricity. Doors open at the pressure of the foot on a mat, and as the steps of the staircase are trodden, masses of soft light glimmer through the semi-transparent walls.

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LOCATION OF GROUND ON LINES.

The "Varley Loop Test"—Its Convenience in the Location of Ground—Special Applicability to Underground Cables in Cities.

The method about to be described of locating trouble from grounds on telegraph, telephone or other wires and cables is an old one, but is in everyday use at the present time by telegraph and telephone companies. It has the advantage of requiring only an ordinary Wheatstone Bridge, and is capable of giving very accurate results. With a good bridge of the portable form which forms a part of the equipment of most electrical distribution companies, a "ground" on a cable or pole line can be located from the office or central station within a few feet of its actual position, thus saving much time and labor which would otherwise be involved by sending a man out over the line to "hunt" the trouble. The great advantage of this ability to electrically locate the fault by a simple bridge test becomes greatly magnified in the case of its application to underground cables. "All wires underground" is becoming more and more the rule, in large cities, at least; and obviously the possibility of definitely and accurately marking the spot where a ground has come in on any particular cable is of great importance. In the case of underground construction by the conduit or "drawing-in" system, it means the obviation of lengthy and laborious tests from manhole to manhole; while in the "built-in" system—of which the Edison underground tubing is an example—it saves the tearing up of the street at a number of places which might be required before the trouble was found.

To pass now to the method of applying this test, the fault

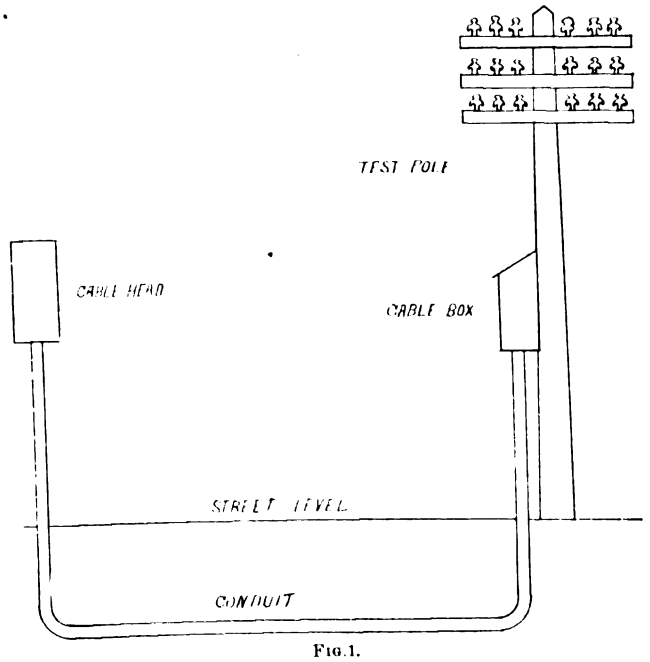

Fig. 1.

which its use enables us to locate—which may be anything from a "dead ground" to a high resistance leak—upon a wire which is otherwise in good condition, *i. e.*, unbroken or free from other trouble. Such a case would be that of a lead covered telephone cable, some of the conductors in which had become grounded by moisture penetrating the cable through a hole in the lead sheath. Such cases frequently occur in the experience of city telephone companies: A small amount of moisture enters the cable through a small perforation in the lead, which may be due to mechanical injury sustained by a blow from a pickaxe in the hands of one of a gang of workmen engaged in laying gas or water pipes, etc.; or electrolytic corrosion of the lead may have taken place at a given point to such an extent as to eat away a spot on the sheath—the result in either case being to ground some of the conductors by the entrance of moisture. In such a case the wires in the cable will become grounded one after another as the moisture reaches them. Hence it is important to locate the fault so as to get at the trouble as quickly as possible. Moreover, the test about to be described cannot be used without one good (ungrounded) wire in the same cable. This can generally be had in the case supposed if the test is made in time.

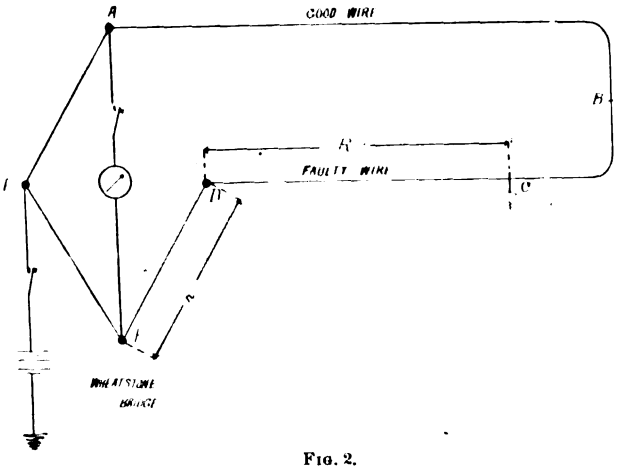

Fig. 2.

On account of the frequency and importance of underground cable trouble like that just referred to, a similar case will be taken in the following description of this method.

Suppose we have a telephone cable consisting of one hundred pairs of wires of No. 19 A. W. G. size, 66 Ohms per mile, insulated with dry paper. The cable is laid in a conduit extending from the telephone office out under the street to a point in the outskirts of the city, where it ends in a "test pole," as shown in Fig. 1. The test pole is the point of junction between the city cable and the pole lines extending out into the country, and has mounted upon it a "cable box" containing binding post connection between the conductor of the cable, which is brought up the pole and through the bottom of the box, and the "bridle wires" leading to the cross-arm above. Trouble has come in on this cable and it is found in the course of regular tests made by the wire chief that out of the 100 pairs of wire in the cable 30 are grounded. The proceedure of locating the point on the cable where the ground has come in is for him to send a man to the test pole *B* to assist in making the connection for the test. Having established communication with this man by means of one of the good pairs in the cable connected to a telephone set at each end, he puts up the connection indicated in the diagram Fig. 2. One binding post of the bridge is connected to a cable conductor which is known to be good, while the other is connected to one of the faulty wires and the "loop" thus formed is closed by the man at the test pole at the wire chief's order. The ground on this wire is represented in the diagram in the usual manner at the point *C*, whose location from the end of the cable it is desired to find. The connection of the bridge battery to the testing set is from the junction of the "ratio arm" of the bridge to ground. The number of cells of battery to be used depends upon the resistance of the line to the fault and upon the resistance of the fault itself. Enough battery should be used to obtain positive deflection of the galvanometer needle, as in any other bridge test.

It will be seen that the diagram, Fig. 2, shows merely a regular bridge circuit, in which the four arms are, respectively *A E*, *E F* (the two ratio arms) *A B C* and *C D F*. In fact the lines are made a part of the bridge connection, with the battery supplied to the proper points on the bridge system through the earth, which then becomes a part of the *battery circuit*. For a balance or no deflection of the galvanometer needle, the following proportion must hold good between the resistance in the bridge circuit:—

$$A E : E F :: A B C : C D F$$

The simplest case is with the ratio arms *A E* and *E F* equal. The balance is obtained with the loop connected to the bridge as

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shown, by unplugging resistance in the arm $D\ F$ in the usual manner. Call the resistance thus unplugged for a balance, r. A similar test is made upon each one of the wires in trouble, keeping the good wire, $A\ B$, in use on one side of the loop, but trying each of the bad wires in turn on the other side, $B\ C\ D$, of the loop. This is readily done, as the wire chief has only to order his assistant on the test pole to cross each of the bad wires in turn to the good wire, at the same time connecting the home end of these wires in succession to the point D on his bridge.

If the fault is of the nature described, practically the same resistance, r, will have to be unplugged in $D\ F$ to obtain a balance on each of the bad wires. On a long cable, with many joints, it may be found that r will vary an Ohm or two in the different tests. This merely indicates very slight differences in resistance that might naturally be expected, due to contact resistance at joints and variation in quality and size of wire. Hence the average of the value r may be taken to represent the resistance to be used in computing the location of the fault common to all of the bad wires.

Having completed the test on the faulty wires in the cable, the assistant at the test pole is told to cross together the end of a pair of the cable conductors known to be good. The resistance of this loop is measured in the ordinary way. Call this L, which may preferably be the average loop resistance of several good pairs in the cable. There have now been obtained—knowing the length of the cable in feet—all the data necessary to locate the fault.

Referring now to Fig. 2, we have for a bridge balance:—

$$A\ E\ :\ E\ F\ ::\ A\ B\ C\ :\ C\ D\ F$$

and if, as assumed, $A\ E = E\ F$ (ratio arm equal) this reduces to

$$1 = \frac{A\ B\ C}{C\ D\ F} \ldots\ldots (1)$$

But inspection of the diagram shows, since the resistance $A\ B\ C\ D$ is equal to L, and calling the resistance $D\ C$, which it is desired to find R, that

$$A\ B\ C = L - R \ldots\ldots (2)$$

Moreover, $C\ D\ F = r + R$

and we may substitute these values in (1) which gives us

$$1 = \frac{L - R}{r + R} \text{ or,}$$

$$r + R = L - R \ldots\ldots (3)$$

which reduces to

$$R = \frac{L - r}{2} \ldots\ldots (4)$$

In words, the resistance from the bridge to the fault along the faulty wire is equal to one-half the difference between the resistance of the loop and the resistance unplugged in the bridge.

Taking a numerical example, say the cable shows an average loop resistance, L, of 102.0^{w}, and that the average of the test made with faulty wires looped with a good wire as shown in Fig. 2 in $r = 39.6^{w}$. Then the resistance R between the bridge and the fault is, by (4),

$$R = \frac{102.0 - 39.6}{2} = 31.2^{w}$$

The length of the cable is known to be 8,160 feet. If L, the resistance of one cable pair, in 102.0^{w}, then the resistance of a single cable conductor for the total length must be half of this, or 51.0^{w}. And the distance from the bridge to the fault is to the total length of cable as the resistance to the fault, just determined, is to the total resistance of one cable conductor. That is:—

$$\text{Distance out to fault} = \frac{31.2}{51.0} \times 8160 = 4992 \text{ feet.}$$

It will be observed by inspection of the diagram, Fig. 2, that the resistance of the fault makes no difference in the result of the test, for by the connections shown, the fault itself becomes a part of the battery circuit supplying the bridge with current, and hence is entirely outside of the resistance forming the four arms of the bridge. This is one point which makes the test so widely applicable.

The location of the fault as computed above may be checked by figuring the portion of the fault back from the test pole, as follows:—

Taking equation (3) and solving it for r, we obtain

$$r = L - 2\ R \ldots\ldots (5)$$

dividing both members by 2,

$$\tfrac{1}{2}\ r = \tfrac{1}{2}\ L - R \ldots\ldots (6)$$

By Fig. 2, $\frac{1}{2}\ L - R$ is seen to be the resistance on the faulty wire between the points B and C, *i. e.*, in the example taken, the resistance *back* from the test pole. The test gave $r = 39.6^{w}$, so $\frac{1}{2}r = 19.8^{w}$, and the location from the test pole is

$$\text{Distance back to fault} = \frac{19.8}{51.0} \times 8160 = 3168 \text{ feet,}$$

which is the difference between the total length of the cable and the distance out from the bridge as already computed.

It will be seen from (6) that it is not necessary to know the actual resistance of the loop, L, nor is it necessary to compute R by (4). If both wires of the loop are alike in length and resistance—as would nearly always be the case in cable testing—it is only necessary to remember the fact shown by (6), *i. e.* that one-half the resistance unplugged, with a bridge connected to a loop made up of one faulty and one good wire, as shown in Fig. 2, is equal to the resistance on the faulty between the fault and the distant end of the loop.

The example of the test above given is based on the assumption that the two ratio arms of the bridge are equal. In some cases, in order to determine with additional accuracy the resistance unplugged for a balance with the connections shown in Fig. 2, it becomes necessary to use a different ratio in the bridge than 1 : 1. In the case where (Fig. 2) $A\ E\ :\ E\ F\ ::\ 10\ :\ 1$, it may be shown that

$$R (= \text{resistance between bridge and fault}) = \frac{L - 10\ r}{11} \ldots\ldots (7)$$

The reader who has thoroughly mastered the principle of this method of locating grounds, as set forth in this article will have little difficulty in deriving (7) for a bridge arranged with a ratio of 10 to 1; or the right formula for any arrangement of the ratio arms of the bridge that might be best adapted to special cases.

J. B. BAKER.

TO SUPERCEDE ELECTRICITY.

It is said that John Jacob Astor has acquired the interest of Mrs. Bloomfield Moore in the Keely Motor Company and will give it financial backing. Mr. Keely has promised the directors of his company that he will be through with his experiments by January 1 next, and that he will then put to a practical and successful test the results of his twenty years' labors. An expert who has investigated Mr. Keely's new force is reported to have said that "There is no use in our devoting any more time to electricity. This is something far better. When Keely has constructed his railway traction engine, possessing rights over all the world, and using a costless force, and when a patent has been taken out on it, the value of the discovery will be found to be incalculable."

One of the directors of the company who recently talked with Keely is credited with the statement that the most wonderful use to be made of the new force is in the push engine, or machine intended to propel street cars or vehicles of any kind on land or in the water. This is described as being a cylinder, eighteen by eight inches approximately, boxed up in portable form. This box is to be fastened to the front platform of the vehicle, and without any gearing or wire connection, or connection of any kind between the box and the wheels, the energy generated in the box is to turn the wheels and push the vehicle along. Some time next year it is expected that people will be able to get light, heat and power for motor purposes in their homes and factories at trifling cost.

First girl—What kind of a job have you got? Second ditto—It ain't a job. I'm following my chosen calling. I'm a telephone girl.—*Philadelphia Record.*

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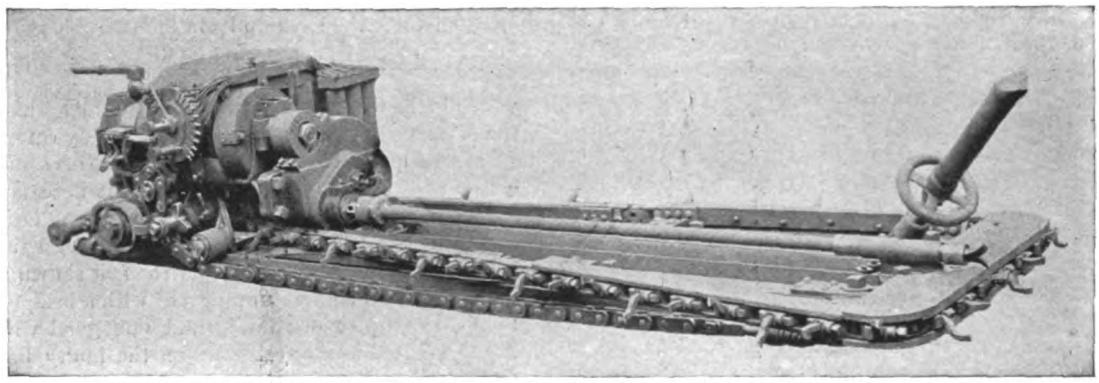
ELECTRIC MINING PLANT.

Essen Coal Company's Equipment at Federal, Pa., the Largest and Best in the United States.

The Link Belt Machinery Company, of Chicago, who some months ago erected a large electric plant for mining purposes for the Essen Coal Company at Federal, Pa., has recently sent out invitations to those who are interested to inspect the plant, now that it is entirely completed and in good working order. The plant is the largest of the kind in the United States, and works so satisfactorily in all respects that other mines are already arranging for a like equipment. The power house of the plant is erected near the bank-mouth of the mine. Its equipment consists of three automatic Corliss engines with cylinders 17x24 in. running at a speed of 153 revolutions per minute and develop over 200 horse-power each. They drive three 150 Kilowatt bi-polar generators "Independent" mining type, wound for 275 volts, and running at 510 revolutions per minute. The station instruments are mounted on a marble switchboard. It carries two Westinghouse circuit breakers, three Weston round pattern ammeters, one voltmeter of the same make, together with the field rheostats and usual switches. Wurt's lightning arresters are placed in each of the two mains leading to the two mines, and also at the bank-mouths.

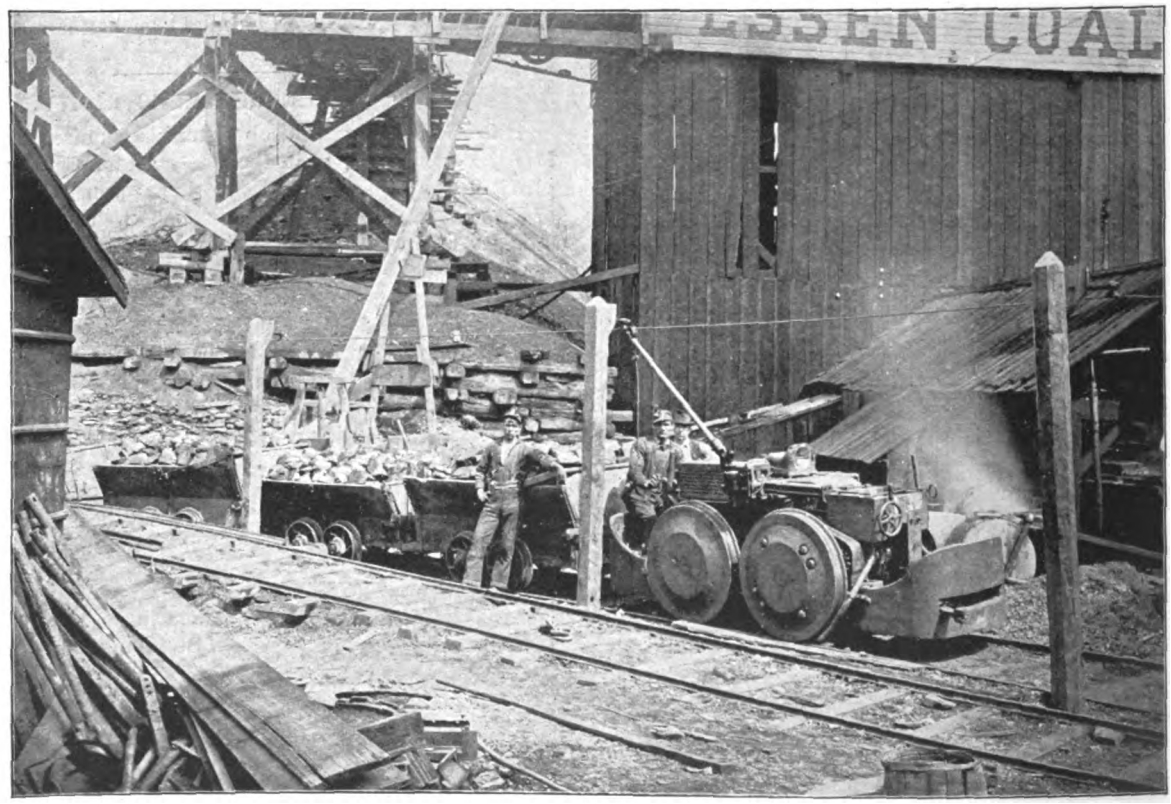
Sixteen "Independent" chain type undercutters are at work, and these, together with two locomotives of 80 horse-power each, one in each mine, are electrically operated, while the lighting of the tipples, power house and underground workings are all electrical.

The coal cutters are each driven by a twenty horse-power "Independent" motor wound for 220 to 250 volts, having but one field coil. The machines are each two feet high, two feet four inches wide and ten feet five inches long when closed. They cut to a depth of five feet, making the cut three feet six inches wide and three and one-half inches high. The machines are easily controlled by a movement of a lever through one hundred and eighty degrees, and may be fed forward, stopped feeding, or reversed without stopping the motor.



"INDEPENDENT" CHAIN COAL CUTTER AT ESSEN COAL COMPANY S MINE.

The locomotives, forty-two inch gauge, are single motor, four-wheeled machines of the "Independent" type. They run under load at about eight miles an hour, exerting nearly 4,000 pounds draw-bar pull, and are each capable of hauling 1200 tons run-of-mine coal per day of nine hours, from the gathering points to the bottom of the slopes in their respective mines. The mule will continue to be employed for the present in gathering trips and distributing empties; the locomotives delivering the loads at the bottoms of inclines from which a drum hoist and cable brings them to the tipples. The trolley wire and feed wires are all bare



EIGHTY HORSE-POWER LOCOMOTIVE, WITH LOADED TRIP AT ESSEN COAL COMPANY'S MINE

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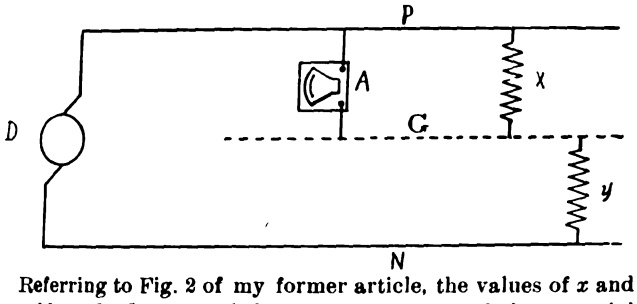
copper. The only insulated wire used is in the tubes to and from the switchboard, and about the tipples and station where lights are used. A ground return is used throughout, the coal cutters being operated on the grounded circuit. For lighting purposes the special "Independent" arc light is used. The difference in the size of the carbon keeps the arc practically central, and although the lamps are run with a resistance in series, the loss is unimportant.

The Link Belt Machinery Company took the contract for the entire plant, electrical and otherwise, delivered and erected. That the equipment and installation was both satisfactory is evidenced by the very excellent work it is doing.

MEASUREMENTS OF INSULATION RESISTANCE.

In an article appearing in THE JOURNAL of September 15, I gave the voltmeter method of determining the insulation resistance to ground upon a two wire system. This was given, not as anything new, but because the method seemed to be so little known. Since the article appeared, I have had several letters that evince an interest in the subject and some of these show that some of the conditions affecting the observations are not well understood.



Referring to Fig. 2 of my former article, the values of x and y could not be determined from measurements of the potential differences between P and G and between G and N by an electro-static-voltmeter, that is, one which gave the actual potential differences existing, unmodified by the introduction of a new path to ground as is done when a voltmeter using current is employed. This will be apparent when it is remembered that the potential differences from P to G and G to N as measured by an electro-static-voltmeter have the same ratio as the resistances x and y, and that the same potential differences would exist for any other values of x and y having the same ratio. What makes it possible to determine the values of the insulation resistances from observations by means of a Weston voltmeter is that these resistances are brought into comparison with the voltmeter resistance which is a known quantity.

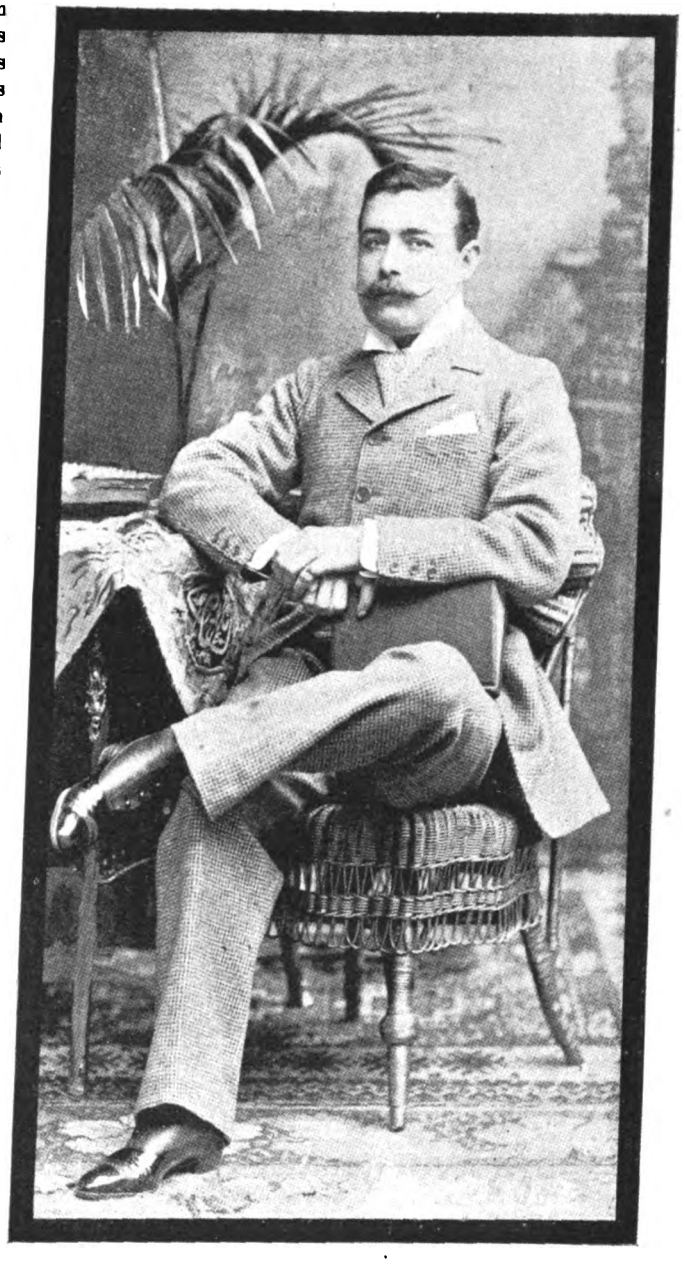
The change due to connecting the instrument can be well seen by computing the potentials from the ground resistances obtained in the last example in my last article. It was assumed in that example that the potentials measured were 10 and 40 volts respectively, and upon this assumption, the insulation resistances were found to be 24,000 from P to ground and 96,000 from N to ground. The potential difference between P and the ground would then be 1-5 of 110=22 volts, and between N and the ground.

4-5 of 110=88 volts.

These are the potential differences that would have been found for this case if the measurements had been taken by an electro-static voltmeter.

If two Weston voltmeters, each having a resistance of 16,000 ohms, had been used to measure the potential differences in the above example, both measurements being taken at the same time the results would have been 36.7 and 73.3 volts.

It is self-evident that nothing in these measurements will show whether the resistance x, say, is due to a single ground connection or to two or more. Even if it were known that there were two connections, no voltmeter measurements could determine their individual values.



JOHN W. MACKAY, JR.

Mr. Mackay, whose death occurred October 18, by being violently thrown from his horse at his county seat 150 miles south of Paris, had a very large circle of friends who mourn his untimely end. Mr. Mackay was only twenty-five years of age. He had been educated at Oxford University, England, and for some time represented his father's interests abroad. In 1890 he was appointed president of the American Forcite Powder Company, of New York. He was also a director and a member of the executive committee of the Commercial Cable Company, and also of the Postal Telegraph Company. In a social way Mr. Mackay was a great favorite, and held memberships in the New York Yacht Club, the Manhattan and the Racquet Clubs. His remains were placed in the crypt of the church of St. Augustine, Paris.

Marcus C. Gormley filed a bill in the Circuit Court on November 14 for a receiver for the assets and franchises of the General Electric Street Railway Company of Chicago, and also to cancel a quantity of stock which he says has been issued to various persons. In August last, the court is told, the General Electric Railway Company employed complainant to "promote" the company. For his services, he avers, he was to receive 500 shares of stock.

Complainant now says the company is not living up to its organized purpose, but is simply in the speculation market.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students. Personal and Pertinent.

PRACTICAL INSTRUCTION.

The necessity for electrical knowledge, beyond that which is simply necessary to enable a person to properly handle machines, is well understood and sought for by a great many engineers nowadays as they see the greater importance of the subject and realize that it has a close connection with steam engineering and that electrical apparatus possesses more of the mechanical features than otherwise.

The theoretical and mathematical parts of the subject are great aids to a complete understanding of the apparatus and practical application of such devices. There are numerous schools of electricity throughout the country some of which give valuable instructions, while there are other schools unworthy of the name, for what they teach is mostly elementary and not sufficiently extensive to cover general practice.

A full understanding of the elementary principles is a great advantage, especially in electricity and magnetism, while the practical application of the elementary principles consists of some things more extensive. A school of electricity to suit the requirements of the practical engineer is something greatly desired and yet there are but few of the schools which teach these important points. Electrical schooling, without practice in the use of apparatus, leaves the student with a very important part of his education yet to be gained—that is, the practical application of his knowledge. The student in electricity will gain much, while studying the text books, if he will try his hand at making apparatus, doing all the work himself."

[The foregoing editorial by the Stationary Engineer is very much to the point and will be endorsed by everyone who has attempted to master the intricacies of the science. If proof positive is looked for it can be found in the fact that those who aim to give instruction have succeeded best where the facilities have been best for demonstrating the principles taught. In addition to the use of apparatus, however, a substantial advantage is to be gained by a greater or less number of earnest students uniting together at stated intervals under proper direction for free and open discussions of the subject. Mutual help is thus afforded and many valuable points are brought out which would not suggest themselves in individual study. Any form of study is better than none at all, and no one can devote his time and attention to the subject without receiving in return much that will be a source of pleasure and profit to him, but in casting about for the best means of acquiring a knowledge of the laws which govern the science and their practical application to everyday commercial use, the more complete the apparatus for experiment, testing and demonstration, the easier and more rapid will be the acquisition of information.—EDITOR]

At Minneapolis, Minn., where the first class of the National School of Electricity was formed outside of the immediate vicinity of Chicago, the work has been of such a character during the past eighteen months as to create a most lively interest in the course of instruction afforded, and has led to the formation of a large class to continue the study during the coming winter. A meeting was held there on Wednesday evening, November 13, which was participated in by Prof. George D. Shepardson, of the University of Minnesota and a member of the faculty of the school. Mr. A. M. Robertson, General Manager of the Minneapolis General Electric Company, Charles L. Pillsbury, City Electrical Inspector, and others who are interested in seeing the benefits of a practical course of instruction placed within the easy reach of those who are desirous of profiting by it. Inspector Pillsbury, who had charge of the classes in Minneapolis last year, will take charge of the new class and give it the benefit of his able services as instructor.

THAT STATISTICIAN AGAIN.

The commissioners of the Niagara State Reservation have appended to their annual report an essay on the subject of the famous Falls, by Prof. J. W. Spencer, who observes that the computation of the age of the Niagara River—based upon the measured rate of recession during forty-eight years, upon the changing descent of the river from 200 feet to 420 feet, and back to 320 feet, and upon the variable discharge of water out of the Erie basin only during three-fourths of the life of the River, and afterwards that all the upper lakes—leads to the conclusion that the Niagara Falls are 31,000 years old, and the river of 32,000 years' duration; also, that the Huron drainage turned from the Ottawa River into Lake Erie less than 8,000 years ago. If the rate of terrestrial deformation continues as it appears to have done, this authority calculates that in about 5,000 years, the life of Niagara will cease. These computations are confirmed by the rate and amount of different elevation recorded in the deserted beaches. It is further roughly estimated that the lake epoch commenced 50,000 and 60,000 years ago, and there was open water long before the birth of Niagara in even the Ontario basin, and that under no circumstances could there have been any hydrostatic obstruction to the Ontario basin since before the birth of Niagara Falls.—*London Electrical Engineer.*

NEW BOOKS.

ELECTRICITY FOR EVERYBODY.—A Practical Book for Beginners. By Philip Atkinson. Author of "Elements of Static Electricity," "The Elements of Electric Lighting," Etc The Century Co., 225 pages. Illustrated Cloth. Price, $1.50.

A book written in simple, practical style, yet comprehensive and accurate, adapted for those who wish a good general knowledge, but who do not care to go into the details of the science. All mathematical demonstrations have been omitted, and all unnecessary technicality avoided; such technical terms as are strictly required being fully explained.

The first four chapters treat of The Nature of Electricity and Electric Transmission, Static Electricity, Batteries, and Magnetism respectively.

Chapters V and VI explain clearly and briefly the construction of the dynamo and motor. Lines, shunt and compound wound machines are well treated and illustrated by diagrams. Alternating current dynamos and motors, which are usually complex for beginners, are in this work so presented that their construction may be easily understood. Considerable attention is given also to present Electric Railroad practice.

Arc and Incandescent Lighting, Electric Heating and Cooking, the Telephone and Telegraph complete the book.

The work is a handy volume of practical information and caters in a popular manner to a demand that exists for information bearing on the nature and general uses of electricity, and will undoubtedly meet with a large sale.

ELECTRICITY DISPALACES AXES.

The lumbermen of Sweden, Norway, Russia and several other countries across the waters, as well as those of British Columbia, Canada, Montana, Wyoming, Minnesota, Wisconsin and Michigan, have a way of felling forest giants which beats anything that can be done with an ax in the hands of the most experienced woodman, says the Brooklyn Citizen. It is one of the most simple operations imaginable, and consists of binding a series of compressed cakes of gun-cotton around the tree trunk with a small copper wire. To this wire a battery of sufficient strength is attached, and at the proper moment a current of electricity is turned on, which explodes the gun-cotton. The force of such an explosion has the effect of felling the tree instantly, the several portions of the trunk being almost as smoothly divided as though the work had been done by a saw.

Send in your subscription to THE ELECTRICAL JOURNAL.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

Of 11,859 miles of new wire strung by the Western Union Telegraph Company last year over 10,000 miles were of copper.

A feature is being introduced into flat building in Chicago which will add materially to the convenience of tenants. In what are known as the Hankins' flats, corner of Thirty-sixth street and Michigan avenue, each one of the fifty-four flats has been equipped with a Farr telephone and arrangements are being made so that connection can be had with the city service. No direct charge will be made to the tenants for the telephone, it being one of the furnishings of the flat covered by the rent the same as any of the other conveniences.

Light and Power.

Iowa has eighty-nine towns with electric light plants.

The Cliff Paper Company, of Niagara Falls, has equipped its mill with electric power as a substitute for three steam engines of over 200 horse-power.

Baltimore is agitating the question of utilizing the Conowingo Falls on the Susquehanna River to generate an electric current. It is said that it is capable of furnishing 25,000 horse-power.

The municipal lighting plant of Allegheny, Pa., to provide for which the issuance of $100,000 in bonds was authorized nearly four years ago, has just been completed and 250 lights turned on.

An accounting will be asked by the Siemens & Halske Company of all parties using the direct current booster upon which they claim patent rights.

The United States is considerable of a buyer of carbons from European countries. During the three months ending June 30, $9,000 worth were imported from Vienna, and from Germany $14,000 worth.

Detroit, Mich., is greatly pleased with its municipal electric lighting service. Electrician Dow's report just issued shows that a material saving over former contract prices has been made and that a much more satisfactory service has been given.

Los Angeles, Cal., has contracted with the Redlands Electric Light and Power Company for 200 horse-power for ten years at $36 per horse-power a year, with the privilege of increasing the requirements to 600 horse-power whenever the city demands it.

La Crosse, Wis., has contracted with the LaCrosse Brush Electric Light Company to furnish 200 lights of 2,000 candle power each to be lighted on dark or cloudy nights for the annual sum of $85 per lamp. The contract runs for five years.

By the derangement of some of the underground feeders of the Edison Electric Light Company, caused by excavations which have been going on in the streets, Chicago was plunged in darkness for more than an hour in the early part of the evening of November 4.

Within the next thirty days Grand Rapids, Mich., will receive five hundred horse-power in the form of electric current from the Grand River and Flat River water power at Lowell. The distance between the two points is 19½ miles and it is claimed that the current can be transmitted with a loss not exceeding 3¾ per cent.

A "fight to a finish" is on between the Salt Lake and Ogden Gas and Electric Light Company and the new Citizens' Electric Light Company. So bitter is the rivalry that the former has expressed its determination to furnish free light for a term of five years if necessary, rather than that their opponents shall gain a foothold.

The Logansport, Ind., Reporter says that the municipal lighting plant of that city is at present running over 3,500 incandescent lamps, from which is derived a monthly revenue of $800. The operating expenses are about $600, leaving a net profit to the city of about $200 per month. In addition to this the city is blessed with an unusually fine system of street lighting.

Railways.

The business done on the Old Colony Division of the New York, New Haven and Hartford Railroad since it became electrically equipped has been 300 per cent. over that of the corresponding period last year.

During the past two years many of the old cable lines of street railway have had to make way for the more economically operated electric lines, and it is but a matter of time when the remaining ones will be changed also. The San Pablo Avenue line in Oakland, Cal., is the latest upon which a change has been determined.

The cars of the Lake Street Elevated Road in Chicago are being equipped with motors and the line will be electrically operated by February 1 next. The system will differ from that employed on the Metropolitan line in two particulars. Gear wheels of compressed rawhide instead of steel will be used in the machinery, to do away with the "roar" that is an unpleasant feature of travel on the present electric "L" road. The third rail will be carried in a conduit, instead of being exposed as in the last named instance. This will prevent the great number of accidents resulting from workmen touching the rail. So many of the employes have been forced from their work by burned hands from this source of danger that a ruling is now in force that any man receiving such an injury is to be discharged at once. This seems harsh, but was found necessary as a means to inculcate habits of caution. The use of a conduit will overcome this disability.

General News.

Twenty-two miles of conduit have already been constructed in Baltimore as part of an extended underground system for the various wires.

The laboratory building of the Rose Polytechnic school at Terre Haute, Ind., was destroyed by fire November 9. The fire was caused by spontaneous combustion. The building and apparatus cost $10,000 and were insured for $5,000.

The National Brotherhood of Electrical Workers held their convention in Washington commencing Monday November 11. A feature of the convention was an electrical parade on the evening of the 14th, in which other labor organizations and several bicycle clubs participated.

The National Board of Fire Underwriters have issued a pamphlet giving the laws and ordinances adopted by various states and municipalities to regulate the installation and use of electrical apparatus. It covers the cities of Denver, Boston, Duluth, Chicago, Louisville, Davenport, Omaha, Kansas City and Minneapolis, and an act of the Massachusetts Legislature for the removal of overhead wires in Boston. The pamphlet will be of great assistance to other municipalities contemplating the organization of electrical inspection Bureaus.

A fire-proof conduit will be placed upon the market within the next thirty days by Osburn Brothers, of Chicago. Unlike conduits hitherto manufactured, it is absolutely fire proof and insulating. It is not more costly, however, to manufacture than less desirable makes and will enter into close competition with the best on the market. A series of vitrified brick tubes are placed within a galvanized steel tube of substantial strength. Elbows, junction boxes and sleeves are provided by which to make an absolutely air-tight and water proof raceway. A feature which is claimed to be of special value is that the tube will last as long as a building, always retaining a perfect raceway. Barton & Brown are the solicitors for Osburn Brothers, and it is safe to assume that their interests will be well protected in the matter of patents which are being taken out.

The electrical illumination of the new Avenue theater at Pittsburg, was given a test a few nights ago and an account of it says that the house shone like a ball of fire. There are 4,000 electric lights tastefully arranged through the building.

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THE TROLLEY IN EUROPE.

Coming into Very General Use—Conduit Systems not Altogether Satisfactory.

Formerly Chicago went to Paris for ideas in methods of municipal improvement, says the Chicago Post, now Paris sends to Chicago to learn the latest and best improvements in connection with certain of the affairs of a great city. Charles Le Blanc, a noted electrical engineer who, in the last few years, has built a number of street car lines in continental towns, has been in Chicago recently inspecting the system of intramural transportation here with a view toward incorporating the best features of it in his future enterprises. M. Le Blanc, who was stopping at the Auditorium until a day or so ago, when he started on his return to France, said that for comfort, cheapness, safety and speed the Chicago street car system surpasses anything to be seen in any of the European cities. He said that the overhead trolley system is having a boom in Europe just now, although the underground system, the storage battery method, compressed air and superheated steam are also used as motive power. M. Le Blanc was for three years chief engineer of the General Electric Railway Company in France, Italy and Spain.

"I have been in Europe for the last three years," he said, "and in that time I have installed the overhead system in Havre, Bordeaux, Lyons and Rouen in France, Milan and Rome in Italy, Belgrave and Servia and a line near Paris. I am here on personal business, but I am availing myself of the opportunity to examine the electric system in use here with the view of adopting and introducing into Europe any new and good feature I may discover in it.

CONDUIT SYSTEM IN BUDAPEST.

"I believe that the only practicable system of operating street cars by electricity is now in operation in Chicago. On my trip to Belgrave, Servia, I had to visit Budapest on several occasions, and one time, remained there a few days to inspect its street-car system. From my observations there I have come to the conclusion that a road like that in Budapest would be impracticable in Chicago for several reasons, one of which is the question of the slot in the rails, which, in a straight street, is four centimeters in width, and in curves at some points it is six centimeters wide. Owing to the narrow wagon tires generally in use in this country, vehicles could not with safety pass along a slot of such dimensions. The wheels would sink into the slot and then there would be trouble for both the wagon and the street car. Another thing that permits conduits to work satisfactorily in Budapest is the excellent streets of that city. Its climate, too, is almost perfection. The streets are built toward the Danube, which is twenty feet lower than the city, giving perfect drainage.

"If I knew nothing further about the Budapest underground system, I should be convinced that it was a failure from the fact that the company which owns it is now putting up the overhead trolley in every part of the city for which it can secure permission. Had the underground system been a success, I do not see why the company would not extend it to other streets. The company has now fourteen kilometers of overhead wires in place. This system, which the Budapest company evidently prefers to the underground system, is the same as that now in operation in Chicago. One of the best proofs that the Budapest system is not being successfully operated is that most of the cities in Germany—Munich, Bremen, Hamburg and Berlin—that have good streets have given franchises for fifty years for the installation of overhead wires. These franchises were not granted until after the Budapest system had been examined by engineers appointed for that purpose by the cities named. I think that action establishes the fact that the overhead trolley is now the most practicable system in use anywhere.

ELECTRIC ROADS IN PARIS.

"Recently I built an electric road within four miles of Paris. It runs from a place called Raincy to Montfermeil. This road is in the suburbs, bnt before very long we intend to run it up to the walls of Paris. The underground system in Washington and New York has not yet been tested by a winter and consequently it cannot be pronounced, as yet, either a success or a failure. But even though the system might prove successful in Lenox avenue, New York, and in Washington, it would still be doubtful if it could be operated in Chicago, owing to the heavy traffic here. There is but little traffic in Washington and in that part of New York where the underground system is in operation. The conduit electric system is utterly impossible in Chicago, as it is in the lower part of New York and in Boston. As I have said, there is an underground system in Blackpool, England, and yet the conservative authorities of Bristol, and of Dublin, Ireland, have given permission lately for overhead trolleys in these cities.

ONE WAY TO AVOID POLES.

"In Italy we have put what we call 'rosettes' on the buildings and attach our span wires to them, thus obviating the use of poles in the streets. This plan is also in use in several cities in Germany. It has given good results there, but it could not be used in the downtown districts in Chicago. In residence districts the people might object to having those 'rosettes' put on their houses. I have noticed that in Europe the people who object most strenuously to the trolley at first are well satisfied with it after it is in operation. In Rome we have a street railway from the main station running over a number of streets for a distance of about three kilometers. The people are so well pleased they favor its extension. The same can be said of the situation in Milan, where we start a line right in front of the cathedral and run on the principal avenues and boulevards a distance of four kilometers. In Milan also there is a road running between the old and the new cemeteries, which are five kilometers apart. This line is used extensively for funerals. The religious ceremonies are held in the old cemetery, where every denomination has a church; then the cortege takes the electric car to the new cemetery, where the interment takes place. This road belongs to the city, but is operated by a company.

EUROPE DOESN'T OBJECT TO TROLLEYS.

"All the electrical roads with the overhead system have given perfect satisfaction in Europe. There is no agitation against the trolley over there. The only thing in that way that troubles us is the false statements regarding the underground system which find their way into the newspapers, and those which are quoted from some American journals. In a European paper there appeared, a short time ago, an article purporting to have been taken from an American paper to the effect that Massachusetts had passed a law providing that all the overhead systems should be abandoned before 1900. This report, although there was no foundation for it, caused great commotion in Europe. Many foreign engineers who visited the world's fair and examined the American street railway systems, reported, after their return, in favor of the overhead trolley system. Firemen in the European cities do not experience trouble from the wires. The underground system frequently gets out of order, and as it can be repaired only by tearing up the street, I imagine it would not be favorably received in Chicago.

"In Paris some twenty cars are being operated by the Mekarsky compressed-air system and fifteen cars by superheated steam, known as the Sapollet system. Neither of these gives satisfaction. They have been in operation only four months. The system of transportion in Paris is very crude. It would not meet the requirements of Chicago for one hour. Most of the people ride in cabs. You can hire a cab to take you from one end of the city to the other for thirty cents. There are now 10,000 cabs in operation in Paris. Those who cannot afford to ride in cabs patronize buses. These are cumbersom, heavy and uncomfortable. The fare charged by these buses is higher than the fare in Chicago streetcars. The buses are divided into first-class and second-class. The first-class is the interior of the bus, and each passenger pays 6 cents, the outside of the bus is the second-class, and the fare is 3 cents. London has the underground steam railway and an underground electric road, but in other respects her systems of transportation are as bad as those of Paris. Chicago has cheaper, better, faster and more comfortable intramural transportation than any city in Europe."

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ELECTRO-THERAPEUTIC DEPARTMENT.

FARADISM IN OBSTETRICS.*

Magical Effect in Selected Cases—Rapid, Complete and Absolute Control of Bleeding.

To the obstetrician electricity is useful chiefly in the form commonly known as the Faradic current, and this he uses ordinarily with a view to hastening processes, delays in which involve danger to the patient. Such for example is the case in the electrical treatment of that form of post-partum hemorrhage which may well be distinguished as atonic, being the hemorrhage of inertia, as opposed to that resulting from a physical lesion. This atonic post-partum hemorrhage is easily recognized by the flaccid uncontracted uterus by which it is accompanied.

In properly selected cases the effect of the application of the current is magical, and the control of the bleeding is rapid, complete and absolute.

My first experiment in the use of electricity in cases of this kind was in 1855, when I applied it to a patient under the care of Dr. J. B. Read, of this city, a Mrs. Wm. C————r. Its application was in consequence of a previous discussion of the subject between the Doctor and myself, resulting in an agreement to test the efficacy of the current in the first suitable case which presented itself. This happened to fall to Dr. Read who still lives to verify these details and dates.

Ever since that time the current has been employed more or less generally in such cases by the physicians of this city.

The one cause which has retarded its more general adoption is the cumbersomeness of the apparatus heretofore presented to the profession, and the other inconveniences attendent on their use, but with the appearance of the portable and efficient batteries now upon the market there is no reason why a suitable battery should not form a portion of the armamentarium of every obstetrician.

There is but little doubt that the use of the current has met with disfavor at the hands of some practitioners who have had failures to report in cases in which they had employed it. So can anyone report failures who use the current promiscuously, as it will not control the hemorrhage consequent upon a laceration, nor could it be expected to do so, and it is its application to these cases; it is a want of proper selection of the cases; it is a certain amount of carelessness on the part of the practitioner which has led to reports adverse to the efficacy of the Faradic current in post-partum hemorrhage.

An extension of application of the principles upon which the electric control of post-partum hemorrhage is founded to the treatment of involution seemed to be legitimate, and to offer a fair prospect of benefitting the parous woman by reducing to a minimum the number of the days of her lying up, and lessening, if not altogether suppressing the diseases consequent upon such involution and the persistence of a relaxed condition of the pelvic tissues.

The very tardy getting up of women after confinement is certainly the result of the artificial lives they lead and their many violations of the laws of nature, in order that they may obey those higher laws of conventionalism which we are pleased to call civilization. These sins against natural conditions often manifest themselves during pregnancy by the thousand and one ailments which are now so common that their absence is regarded as something extraordinary and the result of these conditions is the establishment of that tissue softening which Gravly Hewitt so well describes as a condition precedent to many uterine diseases. The result of this tissue softening is a want of tone, a lack of spring, an inability to recover from a disturbance. Either the nerve power is wanting or the muscle will not respond, or perhaps each cause contributes its share towards a result which is always unpleasant, often disastrous.

In cases having such characteristics the Faradic current will prove of the greatest service, and by its judicious use and the simultaneous employment of careful asepsis and proper supports, it is possible in suitable cases to avoid entirely the days of lying up usual after confinement.

It has not been my good fortune to have had an opportunity to bring these views to the crucial test of practice in more than one case, but in that one a multipara, the result was highly satisfactory the patient remaining in bed but twenty-four hours after confinement, and experiencing no suffering other than the inconvenience of a dressing renewed twice daily for a few weeks and then gradually discontinued, but in this case not only was there no suffering as has just been said, but the treatment proved to be most beneficial, as it resulted in a cure of prolapsus which the patient had inherited from a previous confinement.

*Paper by Dr. R. J. Munn, of Savannah, Ga., read before the Toronto Convention of the American Electro-Therapeutic Association, September 5, 1895.

EXCESSIVE VOMITING DURING PREGNANCY.*

Remarkable Alleviation of the Trouble Through the Use of the Galvanic Current.

Within the last two years we have been enabled to collect, through the courtesy of Doctors Champetier de Ribes, Maygrier and Bar, accoucheurs in the hospitals of Paris a series of fourteen cases of excessive vomiting during pregnancy, which we have treated in the following manner:

The positive pole of a galvanic battery represented by a tin plate the size of a five franc piece and covered with punk and chamois leather is placed at the neck, between the point of insertion *at the* clavicle and sternum of the sterno-cleido mastoid along the course of the vasculo-nervous supply the negative pole represented by a similar disc but of a larger size $\frac{9}{12}$c, is applied elsewhere on the epigastric region.

By means of a collector the number of elements necessary to obtain an intensity of from ten to fifteen milliamperes is caused to enter gradually within the circuit.

The current is passed during from seven to eight miutes, then whilst under the current the patient takes a cup of tea or of bouillon. The current is still continued during the time necessary for the disappearance of the sensation of nausea which happens generally at the end of from ten to twenty minutes, so that the total duration of each application varies between ¼ and ½ an hour.

It is often necessary to repeat these applications several times a day—three and even four times.

In all our cases the results have been most remarkable, and the cure has been effected in a space of time varying from five to eight days.

We only speak of those patients as cured who returned to their normal diet and with whom the nausea had absolutely disappeared. The amelioration is in general progressive, that is to say that day by day one may increase the quantity of accustomed food, but at all times it is prudent not to go too quickly.

Vomiting in pregnancy has certainly a complex etiology. It is certain that a good many cases have their foundation in hysteria, and if such cases are cured we shall only have added one psychical means the more to the interminable list of remedies already prescribed for this symptom so distressing and often so serious.

It is far however, from being thus only—Electrisation succeeds from whatever cause the vomiting may arise, and in reference to this, two observations made by M. Bar during his service in the Hospital of St. Louis are most interesting.

Two women lying side by side in the same ward were suffering from violent vomitings which had reached the second period. The condition of each was most alarming—now the one was manifestly a subject of hysteria whilst the other was albuminuria. The latter was in the more imminent danger and fatal results were anticipated. Now these two sick women from

* Paper by Dr. Gautier, of Paris, read before the Toronto Convention of the American Electro-Therapeutic Association, September 5, 1895.

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the first application of electricity began to take nourishment. They took, within the first twenty-four hours--the one 1¼ litre, the other 1½ litre of milk. They recovered simultaneously and left the hospital almost at the same time.

The undeniable efficacy of the treatment of this symptom from whatever cause it may arise cannot then be doubted.

We have naturally sought in medical literature for observations similar to our own, but we have found none. It is well understood that here we employ only continuous currents--faradic currents have been employed often with success, but there have been many failures, and no author has presented as we do, fourteen cases cured in fourteen cases treated, *all these cases having been under the auspices of doctors from the hospitals.*

We therefore believe ourselves to be the first who have applied a scientific method to the treatment.

ELECTRICITY IN INDIA.

THE ELECTRICAL JOURNAL has a letter from Dr. W. O. Ballantine, of Rahuri, India, in which he says: "I am interested in electricity as a motive power for irrigational purposes. When I was in Chicago I tried to look up some cheap agent for the generation and storage of electricity which could be used in the way I have indicated above, but aside from windmills I found nothing which would supply all the conditions out here. If you happen to be in the way of putting me in communication with any one that could help me to solve this irrigational problem in a cheap way, suitable to meet India's wants, I should feel highly obliged if you would write me to that effect. Coal is too expensive to use out here for motive power, and so all engines are out of the question.

"My idea is that a windmill, such as your Chicago made Aermotor, of which I think very highly, could be placed on one of our high hills and this could generate sufficient electricity to run a pump down in the valley near by. I had not time at the World's Fair to study the matter up, but I saw several persons there who thought the matter a feasible one, but who declared that, although it was feasible, it had not been attempted by any one as yet as far as they knew. If you are in the way of finding out, please write me."

SUED THE WRONG PARTIES.

Suing for damages is very much of a lottery, says the New York Times. One applicant may have the luck all his way, like the young man who, having recovered $20,000 from a railroad company for injuries sustained on its line, has just secured a further verdict for $295 for nurses' bills, while another may be relentlessly harried by perverse fate. A pathetic instance of ill luck in an enterprise of this kind comes from a town in Massachusetts. A citizen while walking down the main street came in contact with a telephone wire, and received a shock which caused him to hop briskly off the sidewalk. The wire had been blown down by a gale of wind, and had fallen across the trolley wire of the electric street railway company. By the time the man reached home his brain was busy with thoughts of redress. Next day he sued the telephone company that owned the wire; the following day he sued the street railway company across whose trolley the wire fell, and the third day he sued the man to whose building the wire was attached. But, alas! when the jury in the first case came in it decided that the accident was the act of Providence. The unfortunate man is still full of fight, but he is at a loss to know whom to sue next.

N. A. S. E. JOURNAL OF PROCEEDINGS.

James F. Edwards, secretary of the National Association of Stationary Engineers, has issued in pamphlet form the proceedings of the Annual Convention, held in St. Paul, September 3-6. Those who are interested in the work of the National Association will find much in the proceedings that will interest them. The Journal contains upwards of 150 pages and is a credit alike to the Association and to Secretary Edwards.

Send in your subscription to THE ELECTRICAL JOURNAL.

GAS VERSUS ELECTRICITY.

In the last few years there has been such an extensive substitution of electricity for gas, that many people have gained the idea the latter is doomed to abandonment in favor of the newer candidate for popular favor as an illuminant. But it seems not impossible that gas will take the front place for the production of power, and it promises to be what most people would call the poorest quality--namely, "producer gas," which scarcely has any value as an illuminant. A recent investigator has obtained some very interesting results of comparison between two engines of 1,000 horse-power each, one of which is operated by the generation of gas, and the other is a steam engine, the energy of which is transformed and transmitted by means of electricity. The gas engine is the more economical of the two.

Gas is claimed to be the most economical form of fuel, at least for a very large number of industrial purposes. The whole of its contained heat energy can be obtained by combustion, and when used in the gas engine, it requires but the minimum of friction, the pressure being applied to the piston at the time when and the place where the pressure is developed. The gas engine can be made to evolve energy only when it is wanted, while an enormous waste is suffered by the running of steam engines at full force when little work has to be done. It is true that the surplus energy in such cases might be stored up in electrical accumulators, but they do not give out all they take in, and probably there always will be a large percentage of loss in the operation. Even when it has an electric attachment the steam plant develops energy which dissipates in the making, while the generator can make gas during a certain number of hours each day, to be stored in the holder till wanted. Also it is possible that there is less loss of power in sending gas through pipes or mains, to be used in generators where the power is wanted, than in the transmission of electrical force along wires for the same distance.

The argument in favor of gas as against steam is strengthened by the reported experience of Mr. W. L. Wildy in making gas in the service of the municipal corporation of Leeds, Eng. Mr. W. says the simplest producer used by him in generating gas for the production of motion is a column of coke about ten feet high. After the distillation of the gaseous product from the fuel there was a residue which made the cost of the gas itself a mere cipher. The by-products were so valuable at the time of the experiment that they paid all the expenses for labor and material, including interest on the cost of the plant and allowance for depreciation, leaving the gas in the holder to cost nothing, except for the items of distribution and collection of accounts. It is fair to assume that if the process used at Leeds should be generally employed, the immensely greater supply of the by-products would result in their extensive cheapening, so that they then would not pay all the cost of producing the gas. But even in that case the cost would be small, and the other advantages noted probably would continue in full force.

The gasmaking at Leeds appears to be in line with a recent discovery, the ownership of the patents on which is now in litigation in the Courts of New York State. It is claimed that this process has brought the cost of making producer gas so low that it must effect a revolution in the production of power. The new departure was the subject of a very interesting discussion at a recent meeting of the American Society of Mechanical Engineers, and the expression of views is reported in Cassier's Magazine.

The electrical manufacturers of the United States are gradually working up a foreign trade that promises to be quite a factor in their operations. During the week ending November 8, the exports were as follows: Antwerp, $2,259; British West Indies, $49; Brazil, $2,110; Havre, $1,287; Hayti, $1,284; Liverpool, $801; Dutch West Indies, $333; London, $1,452; Bremen, $175; Mexico, $1,636; Laguayra, $300; Cuba, $226; Chili, $1,112; Central American, $7,119; Hamburg, $1,152; Naples, $200; Porto Rico, $90; Southampton, $80; Santo Domingo, $192.

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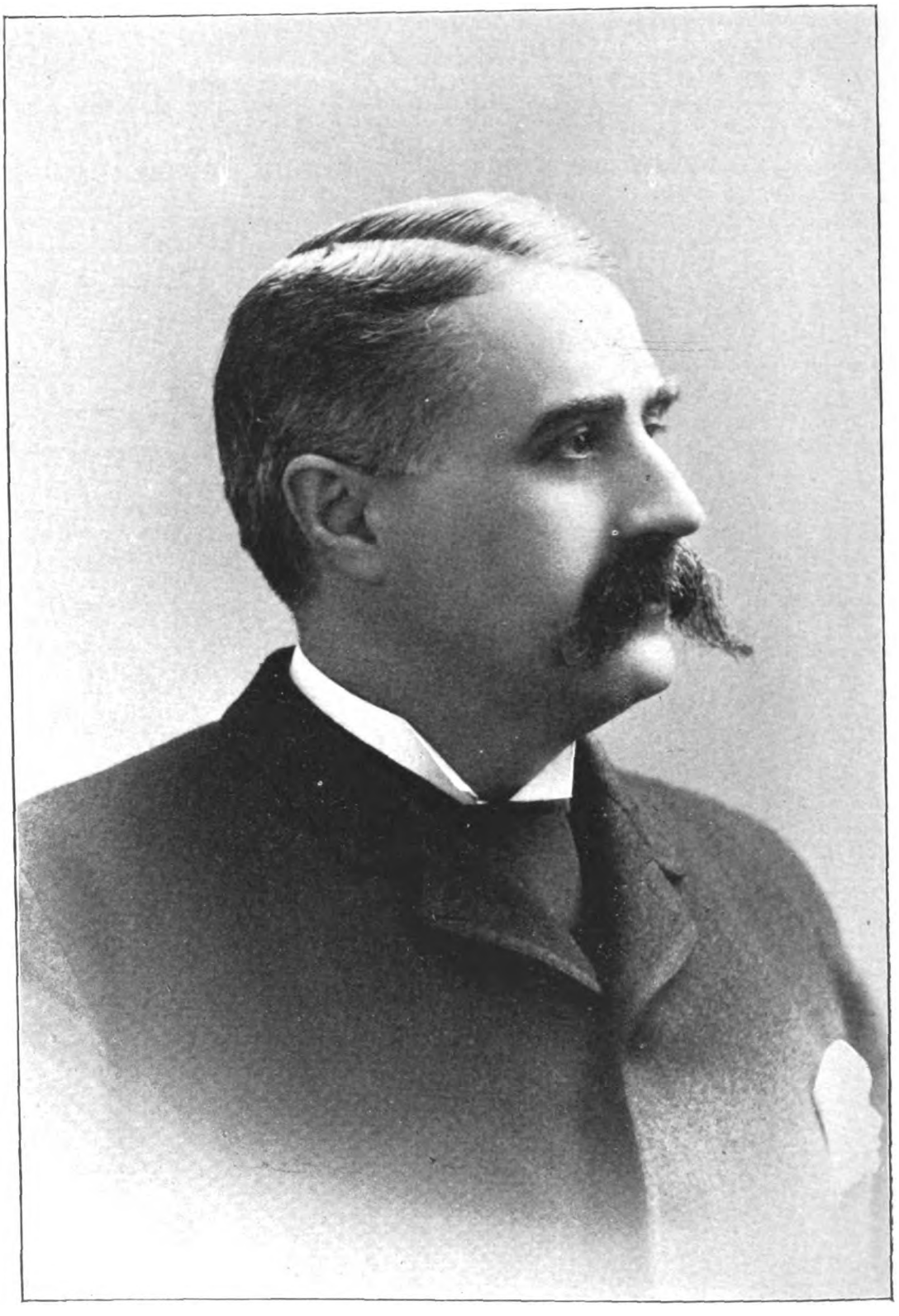

CHARLES FRANCIS BRUSH.

Born 1849. Inventor of Modern Arc Lighting.

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The Electrical Journal.

Vol. 1. CHICAGO, DECEMBER 1, 1895. No. 13

ELECTRIC HEATING OF CARS.

Cold Weather Gives the System a Thorough Test—Metropolitan Elevated in Chicago and Cleveland Street Railway Companies Pleased With It.

COMFORT IS CONSIDERED FIRST, COST SECOND.

The weather during the past few days in many parts of the country has called into active operation the appliances provided for heating street cars and has put to a practical test the efficiency of the electric heater. if any further tests than those already made were necessary to demonstrate the adaptability of this form of heating.

In Chicago the weather has been specially disagreeable and cold and a well heated car was as much appreciated perhaps as it will be at any time during the winter. Under these conditions it has been a matter of satisfaction to the patrons of the Metropolitan West Side Elevated Railroad that the cars have been all that could be desired in the matter of warmth.

Mr. William E. Baker, superintendent of the Metropolitan road, was asked concerning his experience with electricity for heating his cars and unhesitatingly endorsed it as the best system available for the purpose. "It is much preferable to coal for many reasons," said Mr. Baker. "In the first place it is thoroughly capable of keeping the cars warm, that, of course, is the prime consideration. We operate about 140 cars and they are at all times as comfortable as any one could wish for. Then it is clean; no coal to carry in and no ashes to carry out, and in addition to the cleanliness which this ensures there is the saving of expense for this labor which stands to offset in part the extra cost which is supposed to attach to heating by electricity." "But this extra cost," said Mr. Baker, "has not always been fairly computed. For instance it is hardly fair to take a single car and to say 'so much current consumed means so much expense.' We have to produce a given amount of current representing so many kilowatt hours to operate our cars If it takes an extra amout of current, as of course it does, to heat the cars, the question then is, what is the cost of producing that extra current over and above the normal quantity? I have not yet had sufficient time to ascertain exact figures because it was only during November that the cars have been heated, but in looking roughly over the coal figures, and it is in the coal pile that the story will mainly be told, I notice very little difference as compared with the previous month, but I will be prepared to speak more definitely about this a little later on. This company, however, looks primarily to the comfort and convenience of its patrons, if for no other motive than because it believes it pays to do so, and we shall continue to heat our cars by electricity on that account alone if on no other. In order that our cars may be comfortable for the early trains in the morning we place all those that are not in use between one and six A. M. where the current can be turned on to them, and as it is a time of the night when our plant is least taxed, we have an abundance of current for the purpose."

Among the leading street railway companies using electricity for heating their cars may be mentioned the Cleveland Electric Railway Company. A recent communication received from Mr C. W. Wason, the electrical engineer of the company says:

"We have one hundred and fifty motor cars supplied with electric heaters. The last sixty cars put on our road were so equipped, which we think is sufficient evidence that we consider this manner of heating the best, all points considered."

Other street car managers have said that they are holding back in this matter to learn definitely what the experience is of those who have adopted the new system. They appreciate the advantages from certain standpoints, and would be glad to adopt it if it proves not to be too costly. There are again some companies which have experimented with electricity for heating and have discarded it for various reasons. The trouble in such cases has been mainly due, it is believed, to the use of appliances which were not practically adapted for the purpose, When there are found so many large corporations using it satisfactorily and speaking highly of it, it would seem to be safe to assume that under proper conditions the electric current may be economically employed for such purposes to the great convenience of the traveling public.

CURIOUS PHENOMENA OF TWO-PHASE CURRENTS.

The public lighting plant of Detroit includes alternators for lighting the public buildings of the city. The two-phase system was adopted for the purpose of being able to run small motors for ventilation and other purposes by currents derived from the

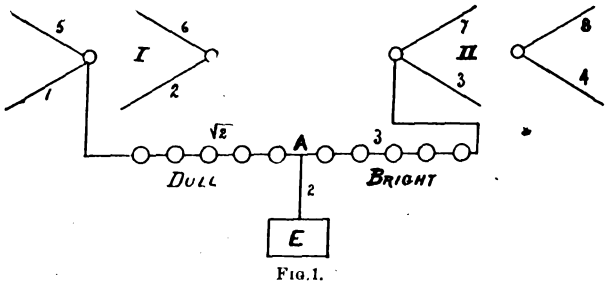

FIG. 1.

lighting circuits. The mains leading to the points of distribution are within the underground district, and are therefore lead-covered cables placed in conduits.

The two circuits from the machine are subdivided into four, as shown in the diagram, Fig. 1, where I is one side and II the other side of the machine. For the purpose of testing for grounds, the terminals of these circuits were brought out in a closed case with fuse blocks, and ten 110-volt lamps were arranged in series with the middle point connected to earth as shown. The circuits all show excellent insulation, but the capacity of the cables is sufficient to give rise to some interesting phenomena,

1. If one end of the series of lamps be connected to any one of the four terminals, the five lamps between that end and the earth will light up with a current of 0.4 ampere. The current is the same whichever terminal is connected to earth. The capacity of the several circuits is not the same; but with this connection, the capacity effective in lighting the lamps is that of the entire system, since the two quarter-phase circuits are electrically united in the armature.

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2. If the two terminals of the lamps be joined to opposite wires of the same circuit, as 1 and 2 or 3 and 4, for example, the lamps light up to nearly or quite full candle power since the potential difference between the mains is about 1140 volts. In this case my electrodynamometer detected no current running to earth.

3. If now one of the lamp terminals be transferred to one conductor of the other quarter-phase circuit, so that one terminal for example is at 1 and the other at 3, then the 3-side will light up brilliantly with a current of 0.53 ampere, while the 1-side will be barely red with 0.25 ampere, and 0.36 ampere runs to earth.

.4 If then either terminal of the lamps be transferred to the other wire of the same circuit, from 1 to 2 or from 3 to 4 for example, then the bright and dull sections of the lamps are exchanged, the bright ones become dull and the dull ones bright. But if both terminals be transferred, so that the lamps are connected we will suppose between 2 and 4, then no change in the brightness of the lamps takes place.

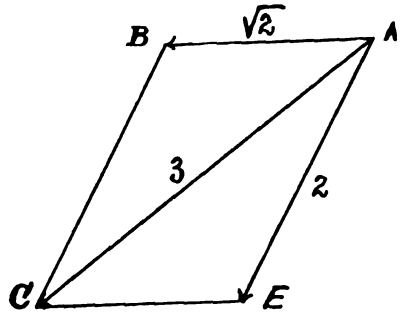

Fig. 2.

The current following to earth and the current in the dull branch are together greater than that in the bright branch. This fact shows that no two of the currents from the point A have the same phase. If we solve the triangle whose sides represent the three currents, which are as 3 to 2 to $\sqrt{2}$, we shall have (Fig. 2) the angle A between the dull lamps and that to earth equal to 58°; the angle BAC expressing the phase difference between the two currents through the lamps, 31°5'. The phase difference between the two *E. M. F's* is 90°, and probably the currents through the mains differ in phase by about the same amount. The effect of connecting the two to earth is then a large reduction of the static potential difference between the two points of attachment to the two circuits. It will be readily seen that if these points, as 1 and 3 in Fig. 1, were joined by a low resistance the potential difference between them would be reduced to zero. The currents through the lamps joining them tend in the same direction of reducing the potential difference. One potential is held back and the other is brought forward.

It is probable that the bright lamps are on the side of the leading current of the pair. This point could not be determined in the time at my disposal and with the apparatus at hand. The transfer of either terminal of the series of lamps to the other side of the circuit to which it is attached has the effect of exchanging the currents, the lagging one becoming the leading one. Thus in Fig. 3 the ordinates represent the potentials of either leading wire above the zero of the earth, not the total potential

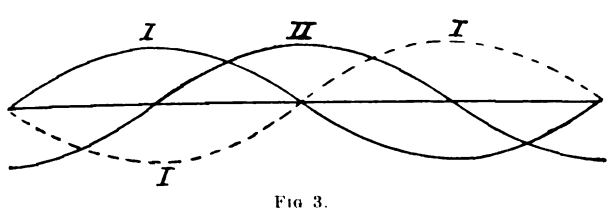

Fig. 3.

difference between the mains. Now the other conductor of circuit I has a potential at any instant differing as much from zero as the first one, but with the opposite sign. Hence the dotted curve represents the potential difference between it and the earth. The full line I leads II by a quarter of a period, but the dotted curve I lags behind II by the same amount, both on the positive and negative sides of the curve. It is therefore obvious that the transfer of one of the lamp wires to the other branch of its circuit reverses all the relations of the currents. the bright lamps becoming the dull ones.

So far as I know this curious phenomenon has not been observed before, because cables are not commonly employed on two-phase circuits. It is evident that caution should be used in handling such circuits, even though they are well insulated, because the static capacity plays a part equivalent to a leak at a distant point on the circuit.

Henry S. Carhart

DELIVERING BREAD BY TROLLEY CARS.

The practical uses to which the trolley car may be put apart from regular passenger service is beginning to develop into considerable proportions and it is not difficult to foresee that it may be utilized and extended far beyond the field that was originally designed for it. A very practical use has been found for it in Newark, N. J., where a contract has been made with a leading bread bakery to deliver smoking hot bread in the early hours of the morning to points within fourteen miles of that city. This work was formerly done by fifty delivery wagons but it has been found that time and money can be saved by the new arrangement. To Jersey City alone eighteen of these wagons have formerly been dispatched; hereafter a portion of these wagons only will be employed to make the local delivery to the grocers, the supply being had from the trolley car on its arrival from Newark. The cars will be run at an hour of the night when they will be unobstructed and will not in any way interfere with the regular passenger service. If the venture is successful, and there appears no reason why it should not be, arrangements will be made to run cars to more distant points. The brewers also are talking of utilizing the trolley for similar purposes, and there are indications that this system of delivery will be used wherever towns are in sufficiently close proximity to make it practical.

ELECTRIC VERSUS STEAM TRANSPORTATION.

Competition between railroads operated by steam and street lines operated by electricity has been growing quite spiritedly of late with the result that steam roads are rapidly waking up to a realization of the fact that in order to hold a fair share of public patronage they must furnish better accommodations and better rates than have been in vogue hitherto.

It is not a matter of record so far as can be learned, with a few possible exceptions, that railroads have gone out of their way to any appreciable extent to accommodate the public, excepting when it became a matter of necessity to protect their own interests, but it has been a noticeable fact that they will expend large sums in order to maintain a position once gained or to compete with rival bidders for public favors in their particular field. The most recent illustration of this policy may be found in the larger cities of the country where electric lines by paralleling the steam roads have made heavy inroads on their suburban traffic and where, in order to protect their own interests, the steam roads have been compelled not only to cut their rates to a competing basis but in addition to put on many more trains and establish quicker running time.

The public exercises the same discrimination in the matter of transportation that it does in other expenditures. It wants the best value for its money that it can get and will transfer its patronage to the line, be it steam or electric, that affords the best facilities for the least money. Electric lines have a little the advantage in the direction of frequent service which is in a measure offset by the quicker time usually made by steam roads, and if the fares are alike for like distances, the result is a close competition without material advantage on either side.

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MEASUREMENT OF INSULATION RESISTANCE.

Applying the voltmeter method to the determination of the insulation resistances on a three-wire system, the results are interesting.

In the figure, let D and D_1, represent two dynamos running in series on a three-wire system of which P is the positive, N the negative and O the neutral conductor. LL are lamps or other translating devices. Suppose a connection from each conductor to ground and let r_1, r_2 and r_3 be the respective resistances from each line to earth. Let a Weston voltmeter be connected from P to earth as shown at W and let its reading be p. Then let it be connected from O to earth and let the reading be k. Finally let it be connected from N to earth and let the reading be n. Let the resistance of the voltmeter be r.

The mathematical operations can be more simply performed if we use in place of the resistances, the conductivities, that is, the reciprocals of the resistances, of the several paths.

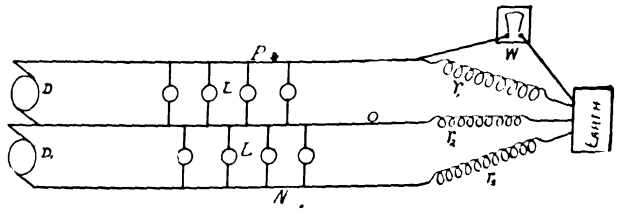
Let

$$a=\frac{1}{r}$$

$$x=\frac{1}{r_1}$$

$$y=\frac{1}{r_2}$$

$$z=\frac{1}{r_3}$$



represent the several conductivities. Let $V=$ the potential difference between P and O, and $V_1=$ the potential difference between O and N.

When the voltmeter connects from P to earth as in the figure, the potential difference between P and earth is p. At the same time, the potential difference between O and earth is $V-p$ and that between N and earth is $V+V_1-p$.

The current flowing from P to earth is $pa+px$; this must be equal to the current from earth to O plus that from earth to N; hence the equation

$$pa+px=(V-p)y+(V+V_1-p)z \qquad (1)$$

In the same way, when the voltmeter connects from O to earth,

$$ka+ky+(V+k)x=(V_1-k)z \qquad (2)$$

and when the voltmeter is connected from N to earth,

$$na+nz=(V_1-n)y+(V+V_1-n)x \qquad (3)$$

Eliminating z between (1) and (3) and between (2) and (3) we have

$$\frac{(V+V_1)n}{V+V_1-p-n}a=(V+V_1)x+V_1y \qquad (4)$$

and

$$\frac{V_1n}{V_1-k-n}a=(V+V_1)x+V_1y$$

The right hand sides of equations (4) and (5) are identical. Therefore neither x nor y can be eliminated, which means that their individual values cannot be determined.

It is plain that the two left hand members must be equal; hence that the three original equations are not independent.

For convenience assume $V=V_1$, the usual case on a three-wire system.

With this assumption equations (1) (2) (3) may be written

$$p\,(a+x+y+z)=V(y+2z) \qquad (6)$$

$$k\,(a+x+y+z)=V(z-x) \qquad (7)$$

$$n\,(a+x+y+z)=V(y+2x) \qquad (8)$$

subtract (8) from (6)

$$(p-n)\,(a+x+y+z)=2V(z-x)$$

comparing this with (7) it appears that

$$k=\frac{p-n}{2} \qquad (9)$$

which shows that the three observations are not independent, but that, either two of the readings having been taken, the third may be derived from these.

Eliminating successively x, y and z from equations (6) and (8) we have

$$y+2z=\frac{2p}{2V-p-n}a$$

$$z-x=\frac{p-n}{2V-p-n}a$$

$$y+2x=\frac{2n}{2V-p-n}a$$

$$x+y+z=\frac{p+n}{2V-p-n}a$$

Remembering that $k=\frac{p-n}{2}$ identical values would be found by elimination between (6) and (7) or between (7) and (8).

It follows, therefore, that the individual values of x, y and z cannot be determined from such a set of observations, but that several different values of these quantities would have given the same readings in testing for grounds by means of the voltmeter:

To illustrate: Assume values of x, y and x at random and work the problem backward to find the readings of the voltmeter. Suppose

$$a=0001$$
$$x=00004$$
$$y=00005$$
$$z=00006$$
$$V=100$$

from (6) $25p=500+1200$

$$p=68$$

from (7) $25k=600-400$

$$k=8.$$

from (8) $25n=500+800$

$$n=52.$$

It is seen that k equals the half difference of p and n. I these readings had been taken, we should have found from (10) (11) (12) (13)

$$y+2z=00017 \qquad (14)$$
$$z-x=00002 \qquad (15)$$
$$y+2x=00013 \qquad (16)$$
$$x+y+z=00015 \qquad (17)$$

Any two of these values is sufficient to determine the other two, and any positive values of x, y, z, that will satisfy either pair of these equations, will give the same voltmeter readings as were obtained above.

Assume $y=0$ then from (14)

$$z=00C085$$

and from

(16) $x=000065$

substituting these values in (6) (7) (8) we have

$$p=68$$
$$k=8$$
$$n=52$$

as before.

Wm. A. Anthony.

KNOWS A GOOD THING WHEN IT SEES IT.

The ELECTRICAL JOURNAL is the name of a bi-monthly journal started in Chicago six months ago. It is well edited and filled with articles of interest to electricians and the general public. Its illustrations are ahead of anything which appears in the periodical press.—*Boston Herald.*

MAKES GOOD ITS CLAIM.

It will be observed that the trolley car not only "claims its victims," but makes that claim good.—*Cincinnati Commercial Gazette.*

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CHICAGO PROTESTS AGAINST THE TROLLEY.

EFFECT OF THE STORM.

The storm which began with a heavy snowfall Sunday night and alternated with rain, sleet, and snow Monday night, may not have been the worst ever known in Chicago, but it caused more inconvenience and danger than has any storm for many years. It blocked and almost paralyzed several cable car systems, it made trolley cars useless a part of the time, and it stopped one of the elevated railroads for six hours. In addition to this inconvenience to travel in the city, the storm did such damage to the telegraph and telephone wires that Chicago was cut off from all communication with the outside world at midnight Monday, train dispatchers were idle in the directing of railroad trains, and telephones were dangerous to their manipulators and subscribers.

These things were inconvenient, to say nothing of the loss of time and the damage to property. But in the breaks on telephone and telegraph wires and their falling across trolley wires there was a serious danger to human life. The trolley wires are supposed to be protected by other wires above them, but this protection proved of little practical value, Monday night. The telegraph wires which broke under the weight of ice that had formed on them fell down upon trolley wires, received their extra current, and became so many agents of sure death to those who touched them. There were loose wires hanging in many streets yesterday as a danger to life.

Some years ago Chicago began a crusade against overhead wires, and Superintendent John P. Barrett demonstrated that wires could be successfully operated under ground. We have moved slowly in this reform of late years, and today there are as many wires overhead as there were when the crusade against them as a nuisance began. To the telegraph and telephone wires have been added the trolleys for the numerous street car systems, and the storm of Monday night gave the public an illustration of what dangers may lurk in these wires when the system becomes demoralized.

We may have reached a place in the history of municipal life where we cannot do without the overhead wires and the trolley, but if so there should be the greatest care taken in putting up these wires so that they will not endanger human life.

A number of horses were killed Monday night, and several persons received severe shocks from broken wires. The condition of Monday night may be repeated several times this winter, unless better means are taken to protect the trolley wires from the telegraph and telephone wires that cross them. In the meantime there should be a general and widespread caution against touching a hanging wire. No one can safely do this without rubber gloves. There is absolute danger in every wire that hangs down in the street, and men, women, and children should be cautioned against this danger until they learn to shun the hanging wire as they do the tottering walls of a building gutted by fire.—*Chicago Inter Ocean.*

A DANGEROUS AND RUDE CONTRIVANCE.

It is not true, as frequently alleged, that no satisfactory progress has been made in using electricity in an underground system instead of in overhead trolleys. In a number of cities, both in the United States and in Europe, surface cars are moved by underground wires with perfect safety.

It is true that these are difficulties, and that these difficulties, most of them, however, capable of being overcome, involve an outlay greater than that attending the overhead system. In Leeds, England, the city engineer devising the plans for installing the conduit system in the central part of the city estimated that a penny per mile would represent the excess of cost of the conduit over the trolley. It is admitted that the conduit system involves an occasional stoppage through short circuiting, brought about by adventitious matter getting into the conduit, and that the wide slot, which appears to be necessary in what is known as the Buda-Pesth system, will prove embarrassing to narrow wheels.

These difficulties appear to have been overcome by Pressley, of San Francisco, in a patent issued by the United States for a conduit electric railway July 2, 1895, and also by a patent issued to the Lavalles, of Holyoke, Mass., the same date. Application for the former had been made February 14, 1894, and for the latter March 17, 1894. Every application for either novelty or improvement in electrical mechanics has been desperately fought by the electrical monopolies:

A patent for an underground trolley was issued July 9 of the present year to Leedham Binns, of Philadelphia. July 29 of this year a patent was issued for an underground trolley system to N. B. Ginochio, of New York, and Henry C. Bridger, of Woodbridge, N. J., application having been on file from December 27, 1894. August 6, 1895, a patent for an underground system was issued to J. T. and W. B. Thomas, of Catasauqua, Pa. August 13, 1895, a patent was issued for a conduit for electric conductors to F. L. Capps, of Newark, N. J. On the same day a patent for a trolley for underground electric railways was issued to M D. Law, of Washington, and another for the same purpose to L. H. Sherwood, of Mount Vernon, N. Y. August 27, 1895, a patent for an underground electric railway was issued to D. F. Graham, of Springfield, Ohio, and W. P. Allen, of Chicago, and another for the same purpose to Emma E. Moore, of Chicago. The same date a patent for a conduit electric railway was issued to Charles H. Johnson, of San Jose, Cal. September 17, of the present year a patent for a closed conduit electric railway was issued to John M. Deal, of Lansdown, Pa. In addition to these a patent for like purposes has been issued to Peterson, of Milwaukee still more recently.

It may be that none of these will solve all the conditions arising from climate, necessary gradients and incidental cost of original plant and installation. The activity of invention along the line of the underground electric in this country is more than matched by like activity by all other countries using popular, cheap, rapid transit, and out of this universal activity there must come eventually a complete and satisfying result.

That so dangerous and so rude a contrivance as the overhead trolley shall continue to prevail in cities is against the lessons taught by the history of all mechanical science. Some forms of the underground trolley are undeniably successful like the Love system in Washington. The Third Avenue system, of New York is undergoing its final test. The Love system is to be tried by the same company on Tenth Avenue. If the tests now being made for the first time against heavy snowfall and ice meet the expectations of those engaged in them, the day of the overhead trolley will have reached its close within a twelvemonth. If the corporations who have put the overhead wires up will not voluntary take them down it is not improbable that the people will give them undesired, but effectual help to that end.—*Chicago Times-Herald.*

LIVE TROLLEY WIRES.

The storm of Monday night ought to cause the citizens of Chicago to ponder on the possible results that may come from allowing more trolley wires to be strung in the crowded districts of the city. When heavily laden with sleet, as they were Monday night, trolley and other wires are very liable to break. When a trolley wire breaks and falls to the street it is exceedingly dangerous. If it strikes a man or a horse the current is sufficient to cause death. In addition to this danger, telephone or other wires that fall and come in contact with a trolley wire thereby become charged and are as deadly to the touch as the trolley wire itself. The use of the telephone when the wire is charged from a trolley wire is also rendered dangerous.

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Fortunately no human beings were killed by these live wires Monday night so far as reported, but horses were killed and several persons were injured, which demonstrates the danger lying in the overhead trolley wire.

These dangers have been called to the attention of the City Council and of the franchise seekers before, but all to no avail. The down town streets have been given over to the trolley whenever asked for, with no attempt to see if underground systems could not be secured instead.

Electric street railway cars with underground connections are in successful operation in other cities, and there is no reason why they should not be tried in Chicago, save that of additional expense to the companies in control. In New York, where overhead trolley wires are not allowed, the companies are willing to put in the underground system. There is a company that has offered, and still stands ready, to put in the underground system in the downtown streets of Chicago, but it evidently has not the right kind of influence with the City Council.

Must Chicago undergo an experience with the trolley that shall prove both costly and dangerous to its citizens before any encouragement will be given to attempts to introduce safer methods of transit in the crowded districts?—*Chicago Record.*

THE OVERHEAD TROLLEY MUST GO.

If there is anything above or below this mundane sphere which should serve as a check to the speed of trolley lines in the center of Chicago, it was last night's storm. And if the distinguished ordinance makers and franchise givers have a grain of sense, they will at once begin to mend their evil ways.

It was as much as an honest man's life was worth to be on the streets last night. Broken telephone and telegraph wires hung across trolley lines, turning the whole city into an electrocution chair. The heavy current of the trolley lines passed to every contacting wire, establishing a perfect and deadly circuit, which interrupted telephonic and telegraphic communication and endangered human life.

These conditions are possible with every big storm. They should warn the council against indulging in further generosity to street railway companies. If the danger last night was great, what will it be when President Wheeler's trolley lines are strung along Clark Street from the South to Washington Street? And when Mr. Yerkes hypnotizes his aldermanic subjects into giving him an overhead trolley loop down town?

The 2,000,000 decent citizens of Chicago have with more or less success dodged grip cars and scooted over grade crossings these many years. The exercise is losing much of its novelty, and with the introduction of the bike is no longer necessary to the rehabilitation of bodily health and to mental activity. While the extension of electric transit lines may be a means of increasing the revenues of aldermen, it is extra menace to human existence and should cease forthwith.

The overhead trolley must go.—*Chicago Journal.*

REMOVE THE DEADLY TROLLEY WIRES.

The storm of last Monday night has demonstrated convincingly to the people of Chicago that the trolley wires which run along many of our streets a few feet above the surface constitute an element of great danger, not only to the property, but to the lives of citizens. It almost may be regarded as a miracle that no human lives were lost in Monday's storm, but even without that the list of casualties in this city since May of last year, only eighteen months, is a fearfully long one. It includes 46 killed and 326 others seriously injured by trolley wires.

The mischief is so easily understood, and its character has been so plainly pointed out in advance by experts, that the giving up of so many of our streets to the trolley deserves to be called "criminal carelessness" on the part of the aldermen who voted for it. The trolley wire is charged with a current of some 500 volts of intensity, sufficient instantly to kill a man or a horse in spite of the assertion by some selfish, cold-blooded persons that the shock from such a current is not necessarily fatal. When loaded down with ice, as many of them were on Monday, the wires are apt to break and fall. Contact with a human being or a horse is almost certain death in such a case, and if the wire falls across a telephone wire, the latter is charged with a death-dealing force that not only menaces people in the street, but all who attempt to use a telephone connected with it. The city fire alarm wires, and those in other electric circuits, are liable to be broken down. They were so badly damaged on Monday night that large sections of the city were left without fire alarm protection; so that the department could not have been notified of a fire in time to prevent millions of dollars from being destroyed by the flames.

Such conditions are all the worse as they are entirely unnecessary. It is alleged by City Electrician Barrett they could be altogether avoided by the extra expenditure of about $5,000 per mile. That amount, he claims, is sufficient to pay for putting of the circuits underground, as is done in Washington, New York, and some other cities. To save this sum, a "paltry" one where big corporations on one side and the public safety on the other are involved, the street railroad companies have perpetuated what Prof. Barrett calls "a prostitution of electrical science," and a majority of our reckless, corrupt city council has aided and abetted them in doing it.

The thing ought to be stopped at once. The currents should be made to run underground. There is no lack of plans for doing it and making the lines better for working than they are to-day. The Brandenburg and Westinghouse systems are held by experts to solve the difficulty and "there are others" claimed to be about as good for the purpose of putting the trolley currents out of the way of doing harm to the people who pass along the streets or own property in the vicinity. The change should be insisted on while the recent disastrous consequences are fresh in mind, for every day of delay is fraught with grave danger to human life. Surely the disasters of Monday should be sufficient to open the eyes of a majority of the aldermen to the criminal folly that has been authorized by the council, and lead them to resolve on a radical reform in this matter at the earliest possible moment. One-quarter of the city wires are already underground. The remainder should be buried at once, and the corporations who own other wires be forced to bury them also, while not another electric wire should be allowed to be strung above ground in the streets of Chicago. —*Chicago Tribune.*

LOCOMOTION OF THE FUTURE.

Under this title M. A. Berthier in L'Etincelle Electrique of November 5, writes very entertainingly. His text is that there is a general rule under which all our previsions, however hypothetical, are based upon certain existing facts where consequences are derived from a more or less well established law.

The author's chief hypothesis deals with the question of the application of electricity by means of a trolley to bicycles and tricycles. His suggestion is that along the public roads should be erected poles along which should be strung conducting wires like those in use for electric roads. Upon the bicycle or tricycle a simple dynamo electric machine should be placed, and by the use of a trolley connected therewith road travel might be made easy and inexpensive. He suggests that the experiments made with high frequency currents may furnish an early solution of the objection to the risks from the current. He goes farther and states that the proprietors of large estates possessing water power, might utilize the force for the production of electric current sufficient for their locomotive needs. He enters into the details of construction of carriages and motors quite extensively and closes by saying that his article may present an idea of what may be the locomotion of to-morrow, if developments continue to be made as rapidly as in the past.

The Revue Generale des Sciences for October 30 contains articles by M. G. Mouret on Entropin, its Measurement and Variations; by M. E. Demenge on The Actual Condition of Work in Iron and Steel; and a Review of Surgery for the year by Dr. H. Hartman.

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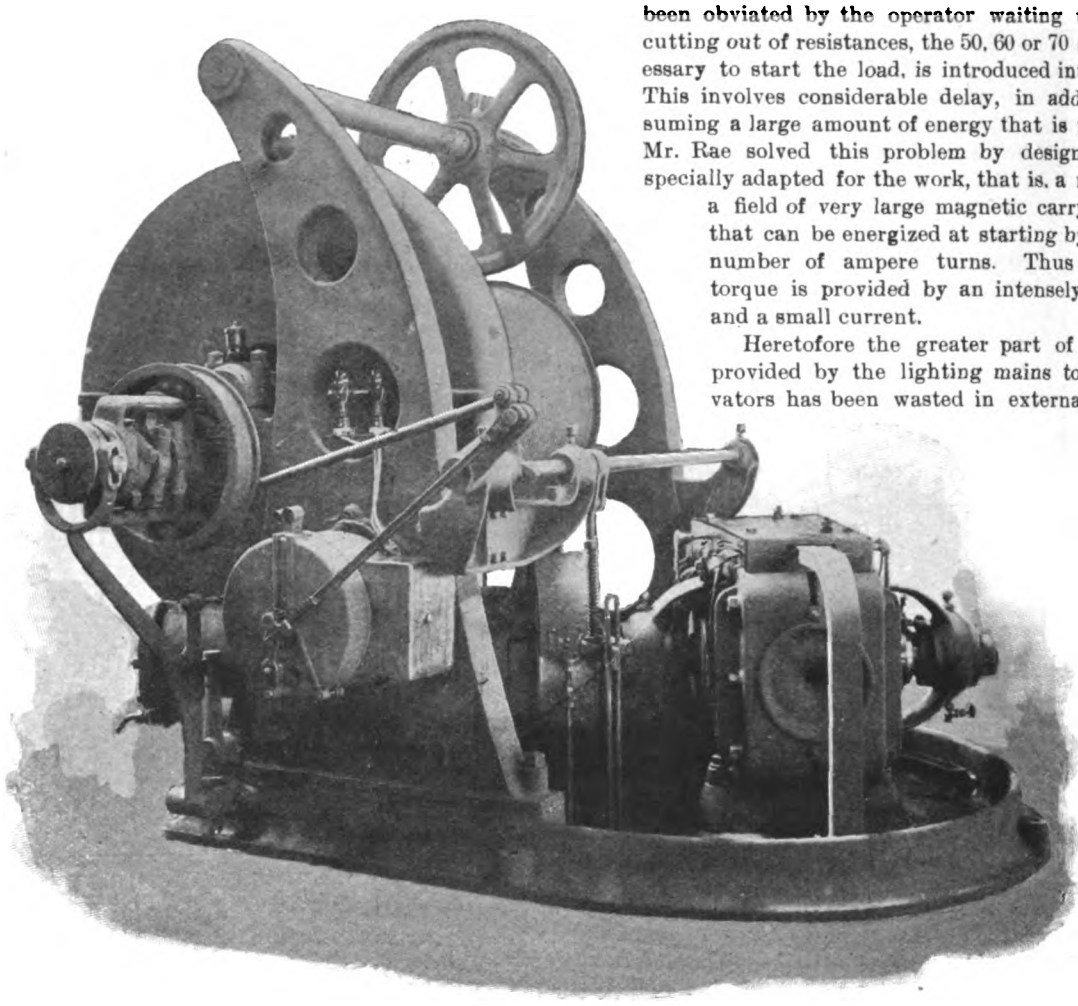
STANDARD ELECTRIC ELEVATOR.

It has been for some time a matter of more or less wonder to those who are interested in the many practical applications of electricity that it had not been successfully adapted to the operation of elevators so commonly used everywhere in large buildings. The facts are that there were many difficulties to overcome and many contingencies to guard against and until quite recently the ingenuity of the profession has failed to rise to the emergency. This is, however, no longer true since the Standard Elevator and Manufacturing Company of Chicago have devised, constructed and placed on the market their new elevator. The electric



NEW STANDARD ELECTRIC ELEVATOR.

design is the work of Mr. Frank B. Rae, the well known electrical engineer, and he has reason to be gratified with the result of his labors.

The claims set forth by the Standard Elevator Company in connection with their new elevator are:

First.—That the operator has complete control of the car. He can move the car the entire distance of its travel at any speed, irrespective of its load. At the same time the design of the motor is such that he cannot damage things by carelessness or a willful manipulation of the controlling lever.

Second.—The car starts immediately upon moving the lever, reaches maximum speed quickly and without jar. This is a feature of vital importance, as it enables the motor to assume a full load without the delay incident to other types of electric elevators.

Third.—The car starts with its maximum load and secures a high average efficiency. As the percentage of total energy expended throughout the day in an electric elevator system is greater for starting the car from rest than in moving it at full speed, this is a matter of the first importance to the owner, who has the cost of operations to meet. The motor is so constructed that no external resistances, dash-pots or solenoids are necessary, the absence of which enables this high average efficiency to be obtained.

Fourth.—The Standard Elevator contains many new and important improvements in safety appliances for protecting the passengers against accident, and the motor from overload or obstruction. In this respect the elevator is the equal of any hydraulic elevator yet designed.

In the introduction of electric elevators the first objection to overcome was that offered by the companies supplying the current. It is well-known that many of the Edison companies refuse to permit more than 25 amperes of current at 200 volts to be drawn from their mains at any one instant, as a greater strain would seriously interfere with the lights. Heretofore this has been obviated by the operator waiting until, by the cutting out of resistances, the 50, 60 or 70 amperes necessary to start the load, is introduced into the motor. This involves considerable delay, in addition to consuming a large amount of energy that is not required. Mr. Rae solved this problem by designing a motor specially adapted for the work, that is, a motor having a field of very large magnetic carrying capacity that can be energized at starting by a very large number of ampere turns. Thus the starting torque is provided by an intensely strong field and a small current.

Heretofore the greater part of the 220 volts provided by the lighting mains to electric elevators has been wasted in external resistances leaving but little for the motor. In the Standard motor, however, there are no external resistances, whatever, the trouble being otherwise obviated.

ELECTRIC TANNING.

Some interesting work on the subject of electric tanning is reported in the Zeitschrift für Elektrochemie by Herr Folsing. The writer states that he has worked out an electrical method of tanning, which he considers is suitable for both thin skins and heavy hides, and only requires three to six days. The tanning pit contains 15,000 litres. Electrodes of nickelled copper are fixed to the walls of the pit, in which the hides are hung so that the current has to pass right through them. A current of 12 amperes with an E. M. F. of 12 volts is used. The color of the leather is not quite satisfactory when commercial unpurified extract is used. The author lays stress on this, and he himself uses an oak extract (with a little hemlock extract added) which is cleared and decolorised by a special electrolytic process. When this is used he finds that the color is exceedingly good and bright. Light cow-hides were found to require 72 hours, heavy cow-hides 5 days, and heavy ox-hides 6 days. The latter would require about a year by the old process.

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THE ELECTRIC EQUIPMENT OF MESSRS. SIEMENS' WORKS.*

This is one of the largest installations in this country for supplying electric power for factory purposes, and is doubly important because tests have been made of the efficiency of the plant, and have been published in a very complete form. The area covered by the works is 6¼ acres, and of this approximately 5 acres are covered by shops and other buildings.

The author visited Messrs. Siemens Brothers' works in September, 1895, and was shown round the shops, the various points of special interest being explained to him. He is also indebted to a paper by Mr. Alexander Siemens, read before the North of England Institute of Mining Engineers in December, 1894, for much of the information here.

Electrically, interest centers around this plant both on account of the use of continuous currents, and also because the pressure of supply is only 120 volts. This low pressure is to be explained to some extent, perhaps, because the firm's stock machines are wound for this pressure, and, therefore, it would have been inconvenient to select a higher one.

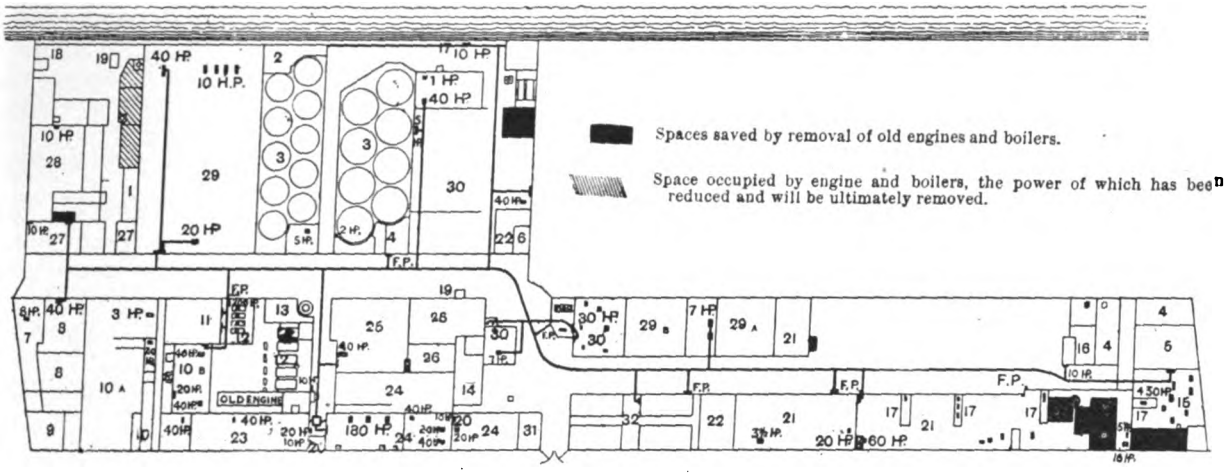
Spaces saved by removal of old engines and boilers.
Space occupied by engine and boilers, the power of which has been reduced and will be ultimately removed.
Entrance.

FIG. 1.

PLAN OF MESSRS. SIEMENS BROS. & CO.'S WORKS, CHARLTON. REFERENCE NOS.:

1. Packing Room and Tinsmith's Shop.
2. Cable Testing Rooms.
3. Cable Tanks.
4. Laboratories.
5. Calibrating Shop.
6. Firemen's Lodge.
7. Lamps and Switches, with Pattern Shop above.
8. Packing Case and Joiners' Shops.
9. Core Testing and Instrument adjusting Rooms.
10. Cotton Covering, above Core Tanks.
10A Core Tanks.
10B Core Tanks, Gutta Percha Shops over.
11. Copper Wire Store.
12. Central Electric Generating Station.
12A Boilers.
13. Condenser Room.
11, 12, 13. (Upper Floor) Gutta Percha Co.e Covering.
14. Hydraulic Testing Shop.
15. Dynamo Testing Shop.
16. Chemical Department.
17. Electric Cranes.
18. Steam Cranes.
19. Weigh-Bridges.
20. Lifts.
21. Dynamo Shops.
22. Stores.
23. Cutta Percha Shop, with Stranding Shop above.
24. India Rubber Department.
25. Wire Winding Shop.
26. Carbon Department.
27. Instrument Department.
28. Insulator, Overhead Line and Battery Department.
29. Submarine Cable Shop.
29A Yarn Winding Sheds.
29B Yarn Stores.
30. Millwrights' Shop.
31. Time Office.
32. General Offices.

Scheme.—This plant has been designed to replace by gradual installments 18 isolated steam engines, capable of indicating collectively 1,446 *h. p.*, corresponding to about 1,150 *b. h. p.*, available for driving the machinery. At the present time (October, 1895) five of the old engines are still in use: three in the gutta-percha department, one driving a portion of the cable-making machinery, and one in connection with some of the hydraulic pumps of the lead-covering presses.

The new central station has an output of about 1,200 *i. h. p.*, which, at an efficiency of 86 per cent., as ascertained by test, gives 1,030 *e. h. p.* at the main switchboard. This corresponds roughly to 1,000 *e. h. p.* at the motor terminals, or about 900 *b. h. p.* on the motor shafts.

Boilers.—At the central station, shown at 12*a* in the plan (Fig. 1), there are five "Gunboat" type boilers, *i. e.*, doule-flued multitubular boilers, each 18 feet long by 9 feet in diameter. They work at 140 pound pressure to the square inch, and have a total capacity of about 2,000 *h. p.* actual. They are fired by hand, and supply steam to the machinery of the central station, to the steam engines driving the gutta-percha shop, and also for heating purposes.

On the roof of the boiler house is placed a number of condensers, each capable of dealing with 25 *i. h. p.* These consist of two cylinders, one placed inside the other. In the annular space formed between them the steam passes from the engines, while cold water trickles down the outside of the larger and the inside of the smaller cylinder. The condensing water thus heated is used to feed the boilers and to supply the gutta-percha and india-rubber washing tanks, and the condensed steam is allowed to run to waste. This arrangement has been adopted in order to meet the special requirements of the works.

In the engine room at the back of the engines there are four sets of double-acting automatic steam pumps for supplying the circulating water, and for maintaining the necessary vacuum in the condensers. The feed pumps are placed above the boilers in the boiler house.

Engines and Dynamos.—The engine room is shown at 12 in Fig. 1. It measures 42 feet by 30 feet, and contains four steam dynamos, each capable of giving a current of about 1,500 amperes at 120 volts pressure, when running at 350 revolutions per minute. The four dynamos are exactly alike, being two-pole drum armature machines of the Siemens *H. B.* 24/36 type, shunt-wound and fitted with switch and resistance for varying the exciting current by hand. Three of the dynamos are driven by William III. type compound-condensing single-acting engines and the fourth by a Belliss compound-condensing double-acting engine.

Main Switchboard.—The main switchboard is divided into two main panels, the right-hand one being coupled to dynamos Nos. 1 and 2, and the left-hand one to dynamos Nos. 3 and 4. In the center is a commutating device by which the omnibus bars of the two panels can be put in series or in parallel, so that power may be supplied either at 120 volts to all the circuits, or

* From a forthcoming work entitled "Electric Motive Power in Practice."

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to some at this pressure and to others at 240 volts, *vide* Fig. 2, in which the arrangement is shown in the diagram.

The positive circuit from each dynamo passes through a main switch, fuse and ammeter, calibrated in kilo-amperes, before entering the positive 'bus bar. There is also a magnetic minimum-current cut-out, shown at *E* in Fig. 2, in the positive circuit of each dynamo, so that when the current from any machine falls below a certain value the circuit is opened automatically. The positive feeders are all connected through an ammeter, switch and fuse, and the returns pass through fuses before entering the negative 'bus bar. The return current is measured by three Aron meters between the dynamo negatives and the 'bus bars, and there is thus a complete record of the output of the station from day to day. Some of the departments are served with two or more positive mains on the same switch

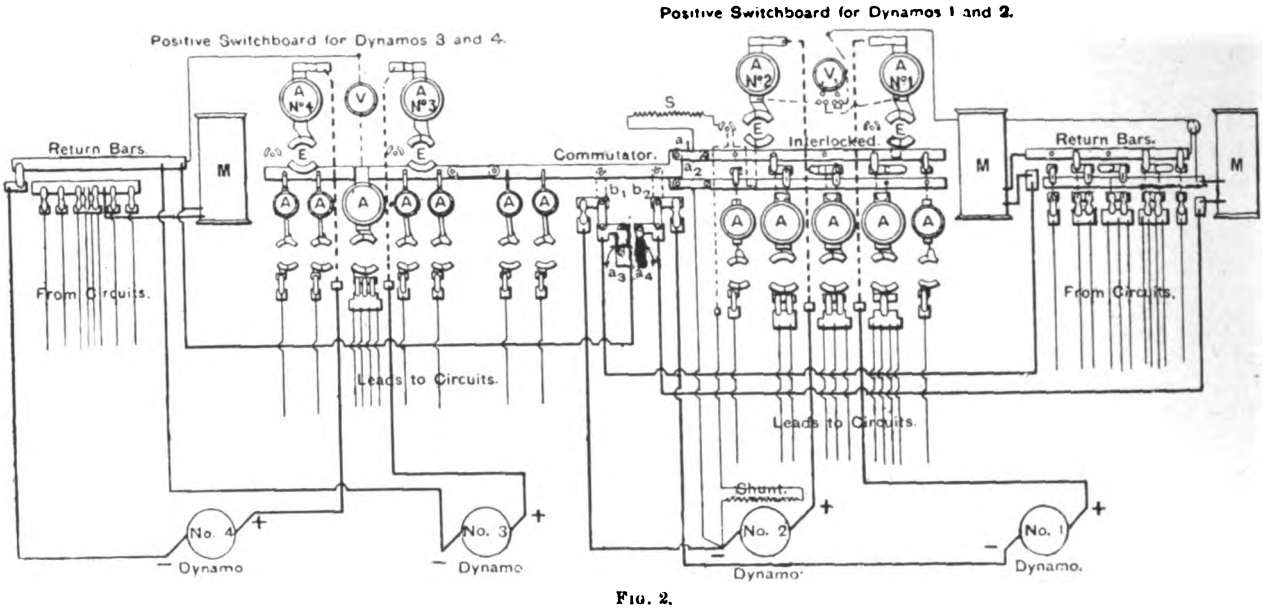

FIG. 2.

DIAGRAM OF MAIN SWITCHBOARD CONNECTIONS, CENTRAL STATION, MESSRS. SIEMENS BROS. & COS.'S WORKS. A—AMMETERS; V—VOLTMETERS; S—SHUNT BREAKING RESISTANCES; E—AUTOMATIC MINIMUM CURRENT CUT-OUTS; M—ARON METER. TO PUT NOS. 1 AND 2 IN PARALLEL, IN SERIES WITH NOS. 3 AND 4 ALSO IN PARALLEL, OPEN SWITCH LINKS MARKED *a*1, *a*2, *a*3, AND *a*4, AND CLOSE THOSE MARKED *b*1 AND B2.

in the station, but subdivided at the shops by distributing boards.

The right-hand panel serves the lead-covering shop, fitters, shop, yarn-winding shed and dynamo shops, gutta-percha department, dynamo-testing shop, fire-engine plugs, submarine cable shop; and there is one spare circuit.

The left-hand panel serves the saw mill, office lights, india-rubber department, winding shop, stranding shop, cotton-covering shop, carbon department and instrument shop; and there is one spare circuit.

The whole of this work is remarkably solid. The 'bus bars have a cross-section of about 6 square inches, and the several connections are of corresponding size. The main connections to the recording meters are made from copper bars 1 square inch, one turn of which passes below the pendulum bob and forms the retarding field. The fuses are all made from flat strip white metal. Copper coupling pieces are used for making all other connections between the dynamos and the circuits.

It is interesting to notice that there are *D. P.* fuses on both mains, but switches on the main positives only. Also there are no switches at the distributing boards, but they are placed on the positive conductors at or near to the motors which they feed. Both arc and incandescent lamps are supplied from the same mains which supply the motors.

To prevent leakage from the conductors to the lead sheathing of the main cables, a tube of india-rubber is drawn over the ends for about 8 inches or 10 inches and lashed with wire to the conductor at one end, and to the lead at the other. This precaution entirely prevents surface leakage between the copper and the lead. The same plan is followed out at all the distribution boards.

Distribution System.—Each department has its distribution board, to which the current is brought from the central station by one or more cables, and is fitted with an Aron meter to record the current used, and in some cases with an ammeter to enable the foreman to gauge the work being done. Each board has two 'bus bars, from which the several service circuits are taken to separate motors in the department through *D. P.* fuses, the switches being placed at the motors in the most convenient position.

All the main cables are lead-covered, served with jute, and armored with steel ribbon. The insulation between the copper conductor and the lead is desiccated jute, impregnated with bituminous compound. These cables are laid direct in the ground without any protection, and have given no trouble. The total length of wire between the switchboard and the distribution boards is a little over 6,000 yards, the area of the cross-section of the copper conductors varying from 0·25 to 1·5 square inches. The service wires from the distribution boards to the motors are all insulated with vulcanized rubber and braided. They are carried in various ways according to the conditions, in most cases being cleated to boards run along the walls or ceilings. Casing is not generally used, except with the smaller sizes of wires.

Motors.—There are about 85 motors, varying in size from one-sixth of a *b. h. p.* up to 100 *b. h. p.*, their total capacity being equivalent to about 1,500 *b. h. p.* The available output at the switchboard of the central station is 1,030 *e. h. p.*, and it is estimated that nearly 900 *b. h. p.* could be taken from the motors at one time. But as the engines and dynamos are capable of exceeding the rated output by from 25 to 30 per cent. for short periods without any risk of injury, it is possible to increase this limit when necessary.

The motors are all of Messrs. Siemens' make and are of various kinds to suit the requirements of the work. The majority are of the two-pole under-type, with drum armatures. The larger ones which work under varying loads, are chiefly shunt wound. A few are compound wound for giving constant speed, but the majority are simple shunt machines. Those which run a fixed load are wound preferably in series.

All of the motors are either encased in sheet-iron boxes or

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protected by iron framing covered with iron netting. This precaution serves to protect the motors from loose pieces of iron which might be attracted by their magnets. It has the disadvantage of making the motors rather difficult of access for examination, etc.; but since they are dotted all over the works – in fact, just where they are of the most service – adequate

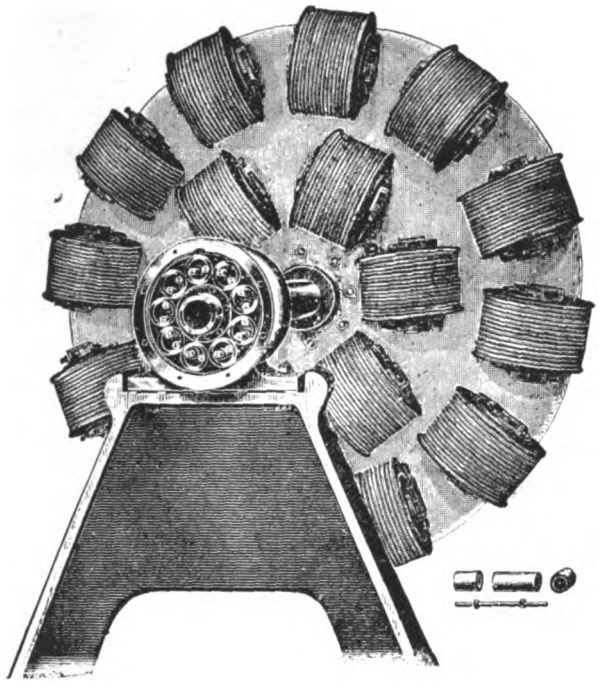

FIG. 3.

MENEELY ROLLER BEARING, ADAPTED TO A CABLE STRANDING MACHINE.

guards are necessary under the Factory Acts to protect workmen from accidental injury.

Some of the larger motors are fitted with Meneely roller bearings, which have proved to be very efficient and economical as regards oil consumption. For example, a 40 *b. h. p.* Siemens 15/20 machine, running at 360 revolutions per minute, having two bearings 2¼ inches in diameter by $7\frac{5}{16}$ inches in length, and one 3¼ inch in diameter by $6\frac{7}{16}$ inches in length, requires one pint of oil per month for the three bearings. This roller bearing is shown in Fig. 3, as it is adapted to a cable stranding machine.

The starting resistances are made of German silver coils placed inside of iron tubes packed up tight with fine sand. Sand is an excellent non-conductor of electricity and a good conductor of heat, so that ample radiating surface is provided, while the whole constitutes a sound mechanical device. The design is patented by the company.

The motors are coupled to their work in a variety of ways, according to the position of the driven machine. In the majority of instances motors drive lengths of shafting by belting, and power is distributed by belts to several machines. This, for example, is the plan adopted in the dynamo erecting shop, where there are two motors, one of 40 *b. h. p.* and one of 20 *b. h. p.*, each driving lengths of shafting. At one end of the main dynamo shop is a new vertical turning and boring machine built by Smith and Coventry, which will tool a circle 18 feet in diameter, with 6 feet between the bed plate and tool bridge. The table is 12 feet in diameter and revolves an annular race in addition to its spindle; its motion is consequently very steady and free from vibration. An adjustable foot-step bearing is provided for raising the table from the annular race when it is desired to run the table at a quick speed. The table is driven by spur-gearing, the large wheel being cast with the table. The main driving gear consists of a 7-stepped pulley with back gear so arranged as to give 21 changes of speed to the table. The feed gears are driven by a friction gearing, by means of which any rate of feed can be given to the tools up to $\frac{1}{8}$ths of an inch. The massive cross slide is hung from screws in the main uprights, and can be raised or lowered by power. The tool-bars are counterbalanced so as to make them easily worked by hand. Both tools are under the control of the workman from either side of the machine. The total weight of the machine is 46 tons, the cross slide with tool-holders accounting for 12 tons. This tool is driven by a separate 5 *h. p.* motor, but in ordinary working it is found that about 4 *h. p.* is sufficient. The motor is coupled by belting to a countershaft, from which the various motions are derived by other belts. Two of the traveling cranes in this shop are each served by a single motor, from which the several motions are driven through gearing controlled by hand chains hanging from the bridge. The third traveling crane has three motors, one for each motion, the whole of the switching being controlled by chains.

In the fitters' shop there is a large shaft lathe, driven by a motor, which is coupled through a speed-reducing gear enclosed in an oil-tight box to a countershaft, whence the lathe is driven through belting and coned pulleys in the usual way, the motor being placed above the machine on an adjacent gallery. A vertical driller has the motor placed on top of the pillar, and is geared through spur gear and belting. A shaper has the motor laid on the ground behind the machine, and coupled through a box gear and belting. A portable emery wheel has the motor belted direct to the spindle of the bob. In the saw mills, the 40 *h. p.* motor which drives the main shaft by belting is erected on iron brackets fixed to the wall, about 8 feet above the floor. A hoist, capable of carrying a load of two tons, used for serving the various floors of one of the main buildings, has the motor erected at the top of the well, and the switching gear is in the cage, connections being made by a flexible conductor. In the rubber department the incorporating rolls are driven in pairs by 40 *h. p.* motors through spur gear. Two callendering machines for rolling sheet rubber are each driven by a 15 *h. p.* motor through a double-threaded worm and wheel running in oil, while the raw rubber washing rolls are driven by a 40 *h. p.* motor through spur gear connected to a horizontal shaft coupled to each machine by means of a clutch gear. Two incorporating

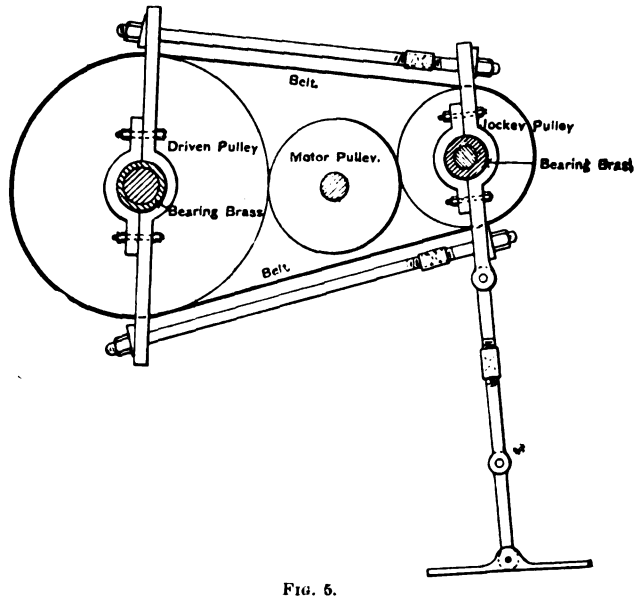

FIG. 5.

FRICTION GEAR IN USE WITH MOTORS.

rolls, used for mixing the vulcanizing and separating materials with the rubber, are driven by friction gear of special interest. The arrangement of the pulleys is shown diagrammatically in Fig. 5. The motor pulley is built up from compressed paper, and both driven and jockey pulleys are well finished in cast iron. The belt serves to produce the pressure between the driver and driven pulleys, and to prevent the side thrust on the motor shaft.—*London Electrician.*

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

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The Overhead Trolley.

In another column, will be found an interview with Mr. J. F. Wallace, chief engineer of the Illinois Central road on the subject of a change of motive power from steam to electricity. His statements reduced to a few words, are that the overhead trolley is not taken seriously by the big railroad corporations, and that nothing will be done in the so greatly to be desired direction until some other system is offered them. Is it not about time that the electrical people went at this problem as though they meant to master it.

There is no doubt, that the insurance people will press their action against the overhead trolley by raising rates on property adjoining the lines.

There is no doubt that water and gas companies will pursue a similar course on account of the electrolytic destruction of their pipes by leakage, stray currents, etc., and the overhead trolley people have had sufficient notice served on them by the people themselves that the dangerous and unsightly thing is simply tolerated until something better is offered. If the electrical people now in the business could monopolize the whole field for an indefinite time, it might be well for them to band together to hold things as they are, until the present equipment on roads wore out, before offering anything in the way of improvement, but there are men clear outside the electrical fraternity who are working at the subject, and we all may just as well admit to ourselves and to each other that there are not so many obstacles, and so abstract a science to deal with, but that some ordinarily bright mechanic may create a perfect success in the way of a conduit trolley. For that matter there are already several systems now offered that would be entirely satisfactory in the hands of one of the large companies. Then why not stop offering overhead equipment, and be honest with the railroad men who are buying in good faith, and who will have to change their plant before the "bugs" are well out of it?

* * *

Chicago, New York and Baltimore, all within two or three weeks, had accidents happen to their electric lighting stations which left certain sections of those cities in total darkness. Philadelphia and St. Louis will undoubtedly be in line when their time comes, but they can't be hurried.

The Motor Vehicle Contest.

The Motocycle contest of Thanksgiving Day, while carried on under conditions of great severity as to roadways, will serve the purpose of a lesson more valuable than if conditions had been more pleasant. A distance of fifty-four miles of the worst possible road was covered in about eight hours. That counts up to about seven miles an hour, especially if we take into consideration two miles traveled by the winner out of the regular course.

No horse or team of horses could have done the task without brutality—perhaps fatal brutality—on the part of the driver.

By the race—that is the road contest—three things are demonstrated:

First. That the motor vehicle can travel under any road conditions.

Second. That the machine is not mechanically perfect at the present time.

Third. That the foreigners, who have been working at the problem much longer than we of this country, have reached a higher degree of perfection, and lastly that Yankee ingenuity may be counted on for a successful achievement.

The Times-Herald has done all it started out to do, that is, stimulate activity in the matter among motor vehicle manufacturers, and there is hardly a doubt that every dollar Mr. Kohlsaat gives out in the shape of prizes will be expended in the further development of those machines that the Judges shall determine upon as the best at the present time.

* * *

The Eye and the Electric Light.

The medical men of England are out fighting the electric light, arc and incandescent, because of the injury done the eye by the brightness of its rays. They suggest an act of parliament to compel the use of opal or ground glass globes.

We fear the gentlemen are straining at gnats. They forget that globes are used nearly everywhere, and are had at small cost. They forget that where lamps are used without globes they are usually located so that their direct rays do not fall upon the retina, and their comparison of the electric light with the sun's rays suggests the query why not pass an act of parliament to either have the sun shaded or prohibit people from looking at it except through smoked glasses—purchasable of the doctors of course.

Our medical friends are needlessly alarmed. The electric light, especially the incandescent light, is the steadiest, clearest, brightest, yellowest and safest of all known lights, and does the eye the least injury of all, because it does not compel us to strain the muscles in order to read. It is the safest because one may not be suffocated by it, as is so frequently the case where gas is used. It is the cleanest because unconsumed elements are not constantly given off to make soot and dirt.

As for the eye—since the science of ophthalmology reached its present high degree of perfection, we all expect to have more or less trouble. It is scarcely ever vouchsafed us poor mortals to be physically perfect, and when we are able to learn, for a consideration, the exact amount of departure from the normal that our eyes show, our more or less vivid imaginations may be relied upon for the rest of the trouble, and we are in the hands of our doctor for an indefinite period, measurable by his comparative knowledge or otherwise, as to what must be accomplished before we may be dismissed "well."

* * *

The Cleveland Crime.

We can fully understand that accidents are likely to happen to any innovation, and years ago we could have excused such a casualty as the recent trolley disaster at Cleveland. But at the present time, we are unable to conjure up any set of circumstances that would exonerate the people implicated. Either the bridge ought to have been closed, or there should have been safe guards at work to prevent the trolley car from reaching a point close enough for its momentum to take it to the water. If

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something has not already been done—and usually the stable is looked immediately after the horse is stolen—a device should be employed to prevent a recurrence. We would suggest that the trolley circuit proper should run over head to within half a block of the bridge on each side. The bridge and a half block on each side should be cut out with a switch. When the bridge is closed and the roadway clear, the current would traverse the two half blocks and the bridge over head as usual. The slightest displacement of the bridge would cut the current from that line. The circuit should have another channel under the river by cable that would be cut in by movement of the bridge. By such means, whenever the car come to within a block of the bridge, it would be out of the power of the motorman or any one to make a mistake. If the bridge were open or displaced ever so slightly, the lights would be out if at night, and in any event the current would be off. The momentum of the car would not be sufficient in any case to propel the car to the bridge over so great a distance. The mechanical and electrical devices for such an arrangement are perfect, and it would require only ordinary skill to employ them. Every road crossing, viaduct or bridge should have them.

* * *

Brooklyn's Bad Case.

Ever since the Brooklyn cars have been propelled by electricity, there has been trouble. An unusual number of accidents have occurred. Many people have been killed. People said the cars were run recklessly and at too great speed. There were indignation meetings. Grand juries indicted railroad men—officers and employes. The speed was greatly reduced by law. Then the people were indignant because the cars traveled too slowly. Recently the "deadly trolley horrors" have divided space in the newspapers with street accidents of other sorts—people being run over by bicycles, buggies, wagons and carriages. Now comes the story of a woman being run over by a beer truck. The next will probably be a scare head column about some man being killed by a baby carriage. We have never given much credence to the old assertion that there are some people who don't know enough to go in out of the rain. We have wondered lately whether the old saw might not be true.

* * *

No Freight for Trolley Cars.

A recent decision of the City Council of Newark, N. J., holds that trolley trains cannot carry freight. We warned the street railway people some time since that the steam roads were preparing to do two things through the courts, namely, prevent trolley roads from carrying freight, and second, compel interurban lines to purchase their right of way through private property. The Newark episode opens up the war in the first case, and unless the street railway people get together for the fight, much prospective and altogether promising business will be lost to them. Both these questions properly fall within the scope of the American Street Railway Association, and no time should be lost in getting down to business. A stitch in time saves powder—or words to that effect.

* * *

The Atlanta Exposition.

Some confidential reports brought back by the recent visitors from Chicago to the Atlanta Exposition, are not very complimentary to the Exposition management. These reports—which by the way are authoritative enough for us to believe, state that the Chicago visitors were handsomely treated all through the south, but that at Atlanta the only hitches during the journey occurred, and these were due to friction between the exposition people and the citizens of the town. The reports go further and state that the exposition was conceived by local real estate men to boom attractive park property, where it is being held. The southern people are entitled to something better than this in the way of representation.

* * *

It is a requisite to the satisfactory heating of street cars by electricity that the current should be turned on.

The National Conventions.

Several of the larger cities of the country are competing for the location of the conventions of the two great political parties. The newspapers and their publishers will be strong factors in the final location of the Conventions, and the newspapers will want the conventions where their news service can be handled. The tremendous record made by the Chicago telegraph offices at the last convention, and during the World's Fair, is being quoted now in favor of Chicago for both Conventions. If the Lake City gets the plums, it will be because her people can handle crowds, and because the telegraph companies can handle news. Electricity wields power in more directions than is usually supposed.

* * *

The Standard Telephone.

Now that President Thurlow Weed Barnes, of the Standard Telephone Company, has secured and published an affidavit from an ex-employe of the United States Patent Office asserting that the Standard Company has better and more non-infringing telephone patents than any other company, we take it for granted that the Standard Company will settle back again into its ordinary gossipy and old womanish ways.

The way to resume, Gentlemen, is to resume, and the way to demonstrate what you have is to do business, or get out of the boat.

* * *

Now that the General Electric Company has determined not to move and as something must be done to "sustain the interest," as the play actors would say, the story is started that President C. A. Coffin is to retire. That story is good for many moons. First we may have Mr. Coffin's resignation all alone. Then the predictions as to his successor—what a world of opportunity opens up on that phase. Then the change of policy—for of course there must be a change of policy with a new president—and before we have rung all the changes, we have gossip enough to last us over the dull season.

It looks very much as though there was to be an era of railway franchise brigandage in Chicago, similar to that *enjoyed* by the gas companies some years ago, and hardly yet passed away. One may not always control enough money to build a road, or even to rent an office in which to set the ball rolling, but one may, without great strain of pocket-book, get up a scheme gratifying to aldermanic, and other pirates, then the rest is easy.

There is as certainly a field in the industries for the storage battery as there was for the trolley some years ago, and for the other forms of electricity that are now so common and necessary. It has remained for well-directed capital to point out the fields. Mr. Gibbs and his associates of the Electric Storage Battery Company, of Philadelphia, "kin, if any man kin."

Brooklyn authorities should give up arresting the railroad people temporarily, as they have been doing that for two years without good result, and start out a few commissions *de lunatico inquirendo* to find out if there are not more than the normal number of citizens who need guardians.

What is the meaning of the oppressive silence of the Buffalo City Council concerning the Niagara power franchise? Does it signify an exchange of civilities and other things between the aldermen and promoters behind closed doors?

It will be noticed that the advocates of municipal lighting are not making the noise. It is the other fellows. We might suggest that in a dog fight it is generally the under dog that does the yelling.

Some day Buffalo will tire of talk and get down to actual business, then will the wheels of her manufactories begin to spin by virtue of the energy of Niagara.

The festive and frolicsome snow plow replaces the erstwhile ditto trolley party these days.

The trolley car continues to be the greatest aid to the infant death list.—*Cincinnati Commercial Gazette.*

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THE JAPANESE NAME UNITS.

The Japanese have entered the lists with our friends of the British Association and have seemingly out Heroded Herod in manufacturing names for units. The London Electrician prints a letter from Japan supposedly *official* which not only shows the Japanese to be abreast of the times, and determined not to be outdone, but also shows that the "French of the Orient" are humorists of the first class, and fully appreciate the craze in England for naming things English names—or it shows that some sly dog of a Britisher is having fun at the expense of the esteemed British Association. An extract of the letter *from Japan* follows:

"Our attention has been called to the claim made on behalf of our colleagues in the United States for rights in a system of names to the magnetic circuit, rights which date antecedent to the German claims of *gauss* and *weber* recently favored by the Britannic Association. We are desired to make known, however, that this claim has been pegged out already before the meeting of the electrical engineers of the United States; and had it not been for recent chastisement operations on a Western neighbor, which has consumed some of our time, this protest would have been made sooner.

"We have now the honor to inform you that three years ago the Institute of Japanese Military Engineers met to consider the question of naming units of all sorts; and after some sittings they issued a comprehensive dictionary of all the units that can ever be wanted, with names attached. They followed the lead of the Britannic Association in selecting C. G. S. units where possible, and in choosing proper names of persons, but they avoid the choice of German and French, and still more of Russian names. The fact that they selected largely the names of prominent citizens of their colleagues in the United States must commend the use of this dictionary to that noble country; but neither have they forgotten the British Isles, as the following quotation will show:

"'The unit of magnetic permeance they named the *Ayrton*, the unit of reluctance the *Perry*, the unit of hysteresis the *Ewing*, and the unit of earth tremor, or vibrations generally, the *Milne*. Further, they named the unit of magnetic induction the *Edison*, the unit of electrostatic flux the *Tesla*, the unit of intensity (of all kinds) the *Silvanus*, and the unit of density the *Forbes*.'"

Bravo for the Japanese! If they can name so well they may continue.

PAYING FOR FRANCHISES.

It has been the custom in Chicago for many years for the city council to grant franchises to corporations asking for them without exacting in return any payment for the privileges thus accorded, so far at least as the public treasury was concerned. It has, of course, been pretty strongly intimated, and probably not without show of reason, that these privileges were not obtained by the companies free of expense, and assertions have been made that the only way for an ordinance to pass the council was that the ways should be well lubricated in advance, but that is neither here nor there so far as the matter at present under discussion is concerned. Whatever monies may have been paid in the form of bribes heretofore, it has now been established that under the present administration, at least, the public must be bribed also. In other words it is expected and exacted that hereafter corporations seeking privileges from the city shall contribute something to the public treasury for value received, just as they would have to do if they were obtaining something of value from private individuals. It is not due to the city council that this change in policy has been brought about, for in two of the most recent instances they voted to grant franchises without any consideration to the city, but it is due to the Mayor, who threatened to veto the measures, that the Calumet Electric Railway Company has agreed to pay $50,000, and the Chicago City Railway Company $25,000 for franchises extending to them the privileges of certain streets which they wish to occupy with their lines. This will doubtless establish a precedent which will be adhered to with more or less variation, according to circumstances. There would seem to be no good reason why public corporations should receive favors from a city without paying for them, more especially when the city stands in need of the money, and when, as in the case of the Chicago City Railway Company, its earnings warrant a twelve per cent. dividend year after year, and with its stock quoted at three hundred, the par value of which is one hundred.

The subscription price to the ELECTRICAL JOURNAL is $2.

ELECTRIC LIGHTING IN CHINA.

The China Gazette says that the Municipality of Shanghai operates 140 arc lamps, lighting about 15 miles of streets. There are also about 40 miles of wire strung, and there are in operation more than 6,000 8-candle power lamps used in private homes. What marvelous effects might be possible in some of the harems of the Orient. But perhaps the harem itself would lose its charm under an electric light.

The degrading advent of nineteenth century science has profaned the sacred precincts of Colombo and the electric fan has superceded the time honored punkah. Next thing we know the eyes of the Indian idols will be lighted by incandescent lamps instead of the far famed diamonds that have been so jealously watched since time immemorial. Or perhaps the "foreign infidel" will be able to exchange a few lamps for a few diamonds.

The Shahzada of Afghanistan on his recent visit to Europe made some very queer "breaks," none funnier than his exclamations on seeing electricity at work in various capacities. King Khama, another Indian prince, has still later been visiting in England and the Continent and expressed his astonishment at seeing people "working lightning with hands and feet."

THE TELEPHONE AS A BAROMETER.

"An Amateur" writing to L'Etincelle Electrique states that the telephone, on account of its marvellous sensitiveness, may be used for the prediction of weather as a sort of barometer in the the following manner: Two bars of iron split and separated at their lower ends in order to increase the surface of contact are placed in the earth at a distance of five or six yards from each other. Every week or two the earth at the faces of these bars is saturated with a solution of chlorhydrate of ammonium. Each of the bars is connected to a telephone in an adjoining house by a conducting wire.

Twelve or fifteen hours before a storm a characteristic chirping sound is heard in the receiver which increases as the storm approaches, a sound like hail on a metal roof. At each lightning flash a sound like a dull blow is heard. Previous to changes of temperature a sort of murmur is heard like the distant song of birds.

ELECTRICITY IN PLANT GROWTH.

Reasons for the great variation in plant growth, when electricity is employed, are suggested by Lieut. Stuart Smith of London. He also offers a possible explanation of the action of light in producing chemical decomposition. In connection with the first part he states that bare wires placed in the ground, so that the current passing between them tends to pass through the roots of the plants, will greatly enlarge the roots of certain vegetables and the tops of others; and he suggests that earth currents, such as are known to exist, might have such an effect on the crops. A carefully kept record may possibly show that over a large area during some years these earth currents may be much above the normal, while during other seasons they may be much below, and an examination of the crops might show heavy and light crops during those periods. Some correspondence has been found between crops and sun spots, and he suggests that earth currents may be the cause, as they certainly correspond with the activity of the sun. He then discusses at some length the effect of light on plants, and offers an explanation of the action of light in producing chemical decomposition on the basis of a true resonance effect.

ELECTRICITY ON THE BATTLEFIELD.

It is stated in L'Etincelle Electrique that during the recent maneuvres in France experiments were made regarding the lighting of the field of battle by means of electric searchlights, but all the models presented were too cumbersome and costly. A more practical utilization of electricity on the battlefield is, however, the suggested employment of small incandescent lights on the helmets of the litter-bearers and physicians similar to those seen in the stage in recent ballets, which could be seen at a considerable distance and by which the wounded might know that succor was near.

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THE ILLINOIS CENTRAL AND ELECTRICITY.

Not Going to Make a Change As Reported—Waiting for More Improved Appliances.

The newspaper reports that the Illinois Central Railroad is about to install a complete electrical equipment for its Chicago suburban traffic, have been premature—not to put too fine a point upon it, and there is not more reason for such an announcement than there would be in the case of any first-class road in the country.

"I have been looking into the motive power question," said Mr. J. F. Wallace, chief engineer of the road, when asked directly whether the plans of his road for the change were matured to the point that details could be had. "I have never presented the matter to our people, and may not do so. But it may come up through some other channel; if so, it would be considered. Quick action in such a case would mean a year or so anyway. You know such corporations move slowly, and we would have to weigh the question from every side."

"To what extent have your investigations gone?" Mr. Wallace was asked.

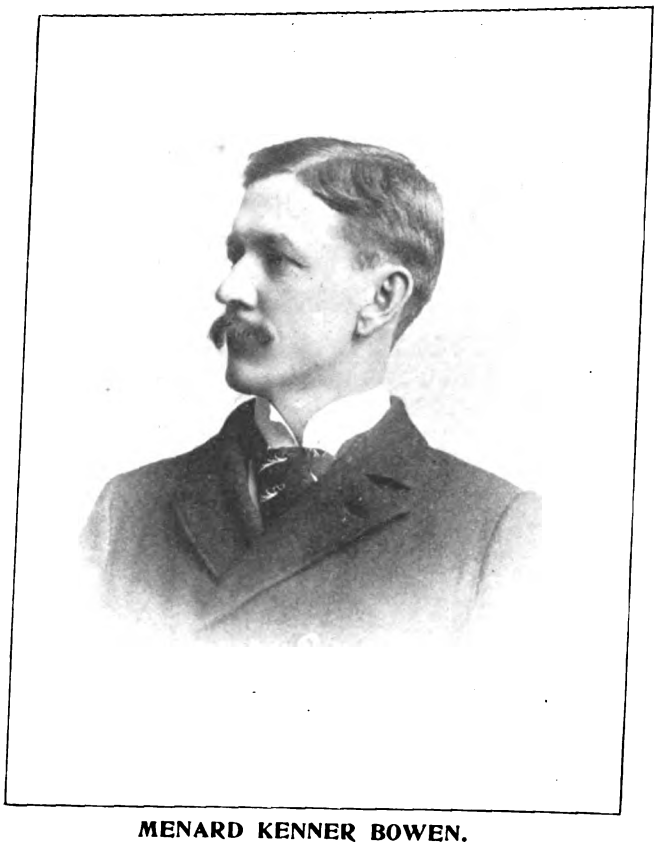
"To this point—I am about satisfied that the overhead trolley is not the solution of the problem of electric transportation, but am also quite sure that the conduit trolley has not yet had sufficient demonstration to warrant us in adopting it at the present time. In other words we are in the same shape Chicago was a few years ago, when there seemed to be a demand for better transportation facilities. The cable was not satisfactory, nor were the horses. The people insisted on improvement, and the only thing that demonstrated success at the time was the overhead trolley, so it was adopted. It would be a difficult and costly thing to adopt a conduit or other system now. So we shall not make the mistake Chicago made, but will wait until something definite is supplied that looks like the ultimatum. Then we will be in the procession."

"What is your conception of the relative merits of steam and electricity for transportation purposes at the present time, Mr. Wallace?"

"Up to date, electricity is preferable for moving small units over short distances rapidly, and with frequent stops. Steam on the other hand is more economical and otherwise satisfactory for moving large loads long distances, with infrequent stops. In other words electricity seems best, everything considered, for suburban passenger service and if as I have said—the ultimate system had been demonstrated, we should feel justified in going into a formal consideration of the matter. When we do get ready, however, to make a change, it will probably take a good while to get things ready. We would probably begin by re-placing worn out equipment with a new kind that would be proper for the new system we proposed to adopt. So you can readily see that many months or even several years might elapse before we had things in shape for a change. We are not like a street road that could change things over the whole road without interfering with others, and even without interfering materially with their own operations. For instance, on our road between Grand Crossing and Chicago, every road in Chicago sends locomotives and trains at times, and any change would have to provide in some way for the convenience of this traffic. Of course in discussing systems we do not consider the third rail like that of the Metropolitan road as feasible, because of the danger to men, and we must always have large numbers of men at work all along the road."

Professor Woodworth of the Michigan Agricultural College will experiment with the storage battery mounted on a wheelbarrow for the purpose of destroying weeds. Wires will extend from the battery and trail upon the ground, thus bringing the current in contact with the weeds. He insists that the Canada and Russian thistle can be destroyed in this way.

The subscription price to the ELECTRICAL JOURNAL is $2.



MENARD KENNER BOWEN.

The subject of this sketch is one of the best known street railway men of this country, and by reason of his urbane manner and sterling business character is one of the most respected. Mr. Bowen was born in the Jefferson Barracks about ten miles from St. Louis in 1856 and received his early education at the St. Louis University and later at the Washington University also of St. Louis, at which latter institution he took a course in engineering which laid the foundation for the achievements in that line which have been his in later years. In 1877 Mr. Bowen went into the service of the United States government as assistant engineer on a triangulation survey on the Mississippi river. He later took charge as assistant engineer of the discharge work and Jetty work in the harbor of New Orleans. In 1880 he became identified with the St. Louis and San Francisco Railway in charge of the topographical survey from Fort Smith, Ark., through to California. In this work he was engaged until 1888 when he went to Kansas City to take charge as chief engineer and superintendent of construction of the cable railway built there at that time. When this work was completed Mr. Bowen went to New York City as representative for the Short Electric Railway where he remained a year, afterwards taking his present position as superintendent of the Chicago City Railway Company. Mr. Bowen was married in 1880 to Miss Allie De Berry, of Jackson, Miss., after a hard fought campaign, participated in by many of the most popular young men of the south, and the defeated candidates have not even the satisfaction of being able to say the young lady would have done better to make another choice. Ever since he went into the railway business Mr. Bowen has been giving his conscience lessons in physical culture. But the son of the late Confederate General John S. Bowen, who lost his life at the head of his troops warring for the lost cause, and the grandson of Lieut. Governor Kenner, the first Lieut. Governor Illinois ever had, and one of the bravest of the pioneers of the West, has never had to practice to increase his bravery. His loyal service in the interests of his employers has often made it necessary for him to use what seemed harsh measures, but he has always been able to retain the warm friendship of even those he was obliged to oppose. Bowen is one of those fellows we can count on to land on the top round of the ladder. Watch for him.

IMPROVEMENTS IN WHEATSTONE'S BRIDGE.

F. Kohlrausch in Wiedemann's Annalen points out some interesting improvements in the Wheatstone Bridge. He uses a long wire wound on a roller along a flat groove, the material of the roller being marble, or wood boiled in paraffin. To increase the accuracy of the readings resistances are introduced at each end of the wire, amounting to 4.5 times the resistance of the wire itself. When the inequality between the two resistances to be compared does not exceed 20 per cent., and the scale can be read to 1 in 10,000, the error of a determination does not exceed 1 in 25,000. A commutator with six blocks admits of putting in the additional resistances on one or both sides.

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THE MOTOCYCLE CONTEST.

Few Starters but a Good Race under very Adverse Conditions. Through Snow and Slush Six Inches Deep—Good Average Time was Made.

FIFTY-TWO MILES IN LESS THAN EIGHT HOURS.

The Times-Herald Motor Vehicle Contest came off on the 28th, Thanksgiving day, under the worst possible conditions as to roads and weather. The snow was not far from six inches deep on the roadways, and it had been frozen and melted alternately, until it was almost impossible for any kind of vehicle to plough through.

The start of the race was made at 8:52 A. M. from Jackson Park and the Illinois Central road. There were six actual starters as follows:

Duryea Motor Wagon Company, Springfield, Mass., gasoline.

De la Vergne Refrigerating Machine Company, New York, gasoline.

Morris & Salom, Philadelphia, electric.

H. Mueller & Co., Decatur, Ill., gasoline.

R. H. Macy Company, New York, gasoline.

Sturges Electric Motocycle, Chicago, electric.

The Morris & Salom people were not prepared for such rough weather, and had not set enough batteries at the relay stations, consequently they made no attempt to cover the course but simply ran to Lincoln Park and back.

The Sturges machine found the going too heavy, and also went out of the contest at Lincoln Park.

The Macy and De la Vergne machines both got out of order, the former going out almost at the finish. This left the going to the Duryea and Mueller wagons the latter of foreign make using Benz gasoline motor. The time made by the winner was seven hours and fifty-three minutes, that of the second vehicle being nine hours and twenty-eight minutes, the distance being fifty-two miles.

The judges will award the prizes after thoroughly considering all the conditions of the contest and weighing the points of all the vehicles. Speed is not of prime importance in the contest, but the severe conditions of the road race will weigh heavily in balancing up all the points of excellence including general utility and practicability. It will also be necessary for the judges to have full reports of the scientific tests from the engineering committee.

The Mueller machine has been described in a previous issue. The Duryea vehicle is of American design and many improvements have been lately made by Chas. E. Duryea of Peoria, Ill. It weighs 700 pounds and can attain a speed of twenty miles an hour. On good roads it has already reached even a higher rate of speed. Its motor is a four-horse power engine and weighs 120 pounds. The diameter of the front wheels is 84 inches; of the rear wheels, 88 inches. Only five minutes is required in replenishing its fuel supply. The arrangement of the gearing is such that the carriage can be made to run from three to sixteen miles an hour, and the gradation from the minimum to the

BOARD OF JUDGES.

MAJOR GENERAL WESLEY MERRITT HENRY TIMPKIN JOHN P. BARRETT
L. L. SUMMERS CHARLES F. KIMBALL COL. M. LUDDINGTON J. ALLAN HORNSBY

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maximum degree of rotation is accomplished without the motor changing its rate of speed, the pressing of a button effecting this object.

The axletrees of the carriage are fitted to the body, dividing at the ends into vertical forks, into which are fitted pieces like ordinary carriage hubs in shape, which hold the axle. Bolts run through these pieces, and a connecting rod of iron, extending back of the axletree and joined at the centre of the wagon with the steering device, makes the separately swung wheels work together. The lateral movement of the lever turns the wheels, and the vertical movement starts or stops, changes the rate of speed and reverses its movements, driving it backward when desired. Ball-joints and ball-bearings minimize all effort and minimize the power used. The brake drum is under the seat and is controlled by a wire with a button at the front corner of the seat by which, under a speed of twelve miles an hour, the vehicle can be stopped in a few feet.

JOHN LUNDIE,
Engineer.

By the proper arrangement of gears, cones and levers a change of speed is instantly effected by the vertical movement of the lever. In this machine the steering heads are placed as close as possible to the wheels, and at the same time are so angled that their line strikes the plane of the wheel at just the point a stone or other obstruction would naturally be encountered. This does away with the leverage, which tends to turn the wheel by breaking the force along the line of the head.

Among the advantages claimed for the Duryea machine, are, little noise or odor, excellent springs, four speeds—five, ten and twenty miles an hour forward, and three miles an hour backward; can be quickly geared to different speeds; can be run at any speed desired below its limit; its fuel costs less than ½ cent

THE DURYEA MACHINE.

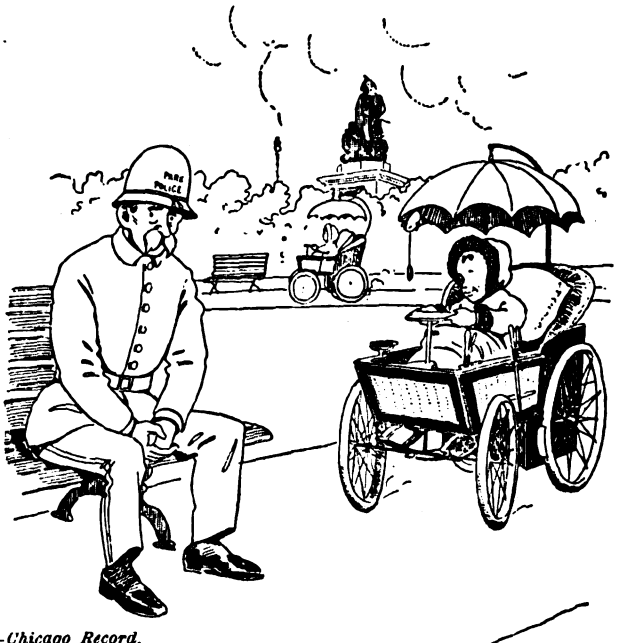
per mile, it carries eight gallons of fuel; runs from 100 to 200 miles without refilling; has self-oiling motors and bearings; will not jerk the levers out of the driver's hand, and is not dangerous either from fire or explosion.

It was the hope of the promoters of this motocycle contest that by it American inventers would be stimulated in a new and most important field, a field which, for some perverse reason, had been pre-empted abroad and neglected at home, and one in which the United States was vitally concerned. Of all countries this depends most largely for its continued supremacy upon the excellence of its transportation facilities. It is a country of magnificent distances, with clearly marked centers o exchange and distribution.

The response of American inventors to the offer made by

H. MUELLER'S MOTOCYCLE.

the Times-Herald has never been equaled in the history of mechanical progress. Iu June of this year perhaps four inventors were at work on motocycles which possessed any features of practicability. Since that time 500 applications have



—*Chicago Record.*

WHAT WILL THE POLICEMAN DO NOW?

been filed in the patent office at Washington on inventions pertaining to this branch of transportation. Not less than 200 distinct types of motocycles are now in process of construction. Who shall say what will be evolved from this combined study and skill of men well versed in the problems seeking solution? Few of these inventors were able to bring their constructions to a point where it was possible to attempt a practical demonstration. Not a vehicle which entered the competition represented the conception of the man who designed it. Added to this came the almost disheartening incident of a weather condition absolutely without precedent at this season of the year.

By far the most important features of the contest are the scientific engineering data that the preliminary tests will afford to inventors who purpose to go on developing the motor vehicle. No contests held therefore have covered any tests excepting the road race and there have not been any figures showing capacity or efficiency of motor vehicles, but in this case such data will be fully furnished.

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A NEW ELECTRIC MOTOR.

Company Has Been Formed at Madison, Wis., to Extensively Carry on Its Manufacture.

A corporation to be known as the Northern Electrical Company has been formed at Madison, Wis., for the purpose of carrying on the manufacture of electrical apparatus, chief among which will be a new motor to be known as the "Northern." Senator William F. Vilas is the president of the company, A. O. Fox is treasurer and business manager, C. M. Conradson is mechanical engineer, and Prof. D. C. Jackson, of the University of Wisconsin, electrical engineer. The new company has for some time been erecting work shops and perfecting their new motor, and they are now about ready to do business. Meantime orders have come to them which ensures a large trade right from the very start. The main building of the company is a structure 150 feet long by 100 feet wide, and so arranged that it may be extended to the length of 500 feet.

The power house is adjacent and separate from it, so that no fire will be used in the main building, the main shop being heated by steam supplied from the power house. The entire plant has been laid out with a view of economizing labor at every stage of manufacture and to avoid the wastes so common to many manufacturing plants. A railroad track runs through the center of the building, and all the supplies which are to be brought in by rail may thus be deposited in the shop at the most convenient place for manufacture, as well as the product be carried away. All heavy castings are unloaded directly in front of the machine tools on which they are to be finished. The entire shop is so arranged that each piece as it undergoes the various steps of manufacture moves progressively forward from one machine to the next until it is finished and ready to fit into its place in a completed motor, or go into the store room. The shop is so arranged that a large traveling crane can be installed for handling the heavy machinery.

The machinery which is being installed comprises lathes of various sizes, milling machines, boring machines, polishing machines, planers and many other descriptions of machines. All machinery will be driven by motors manufactured by the company, and power will be supplied through a large dynamo by a fifty-horse power, double cylinder Raymond gasoline engine. The wires of the Four Lakes Light and Power Company are also carried into the factory for use when need be. The company, however, will furnish its own light, as well as its own power, ordinarly. Twelve arc lamps will be used for the lighting of the machine shops. The steam is carried through a system of steamheating pipes and is used only for this purpose. These pipes are suspended overhead, out of the way.

The motor which the new corporation will manufacture has some special features which it is believed by its owners will give it a preference over any other now in use for furnishing power for driving machinery. Among these special features is that of adjustability by means of which this motor fastens to the ceiling as readily as to the floor without interfering in any way with proper action at the bearings. It is said that no other motor made possesses this valuable feature. It recommends itself at once to a large class of manufacturers whose floor space is expensive and limited. They can attach these motors directly to the ceiling, and thus have available much additional floor space, rent free. Another advantage of the motor lies in the neatness and compactness of mechanical construction. Still another advantage is that by the use of a number of motors in a shop or manufacturing establishment the extensive shafting and belting by which power is generally carried from the engine for the different machines are dispensed with and the waste of power employed in turning shafting and in driving belts may be saved. This system permits of independent short shafting for each machine, so that the shafting may be shut down in part of the works without interfering with the work going on in other parts. It is estimated that the loss of power by this method of transmission is about one-third as much as the loss sustained by the ordinary method of steam power and long line shafting—a difference of as much as sixty per cent. in power in favor of the method of electrical equipment, besides a further great saving in wear and tear of the machinery. Thus, this motor will carry power into the various manufacturing shops in the larger cities where every square foot of floor space costs money without requiring floor space. It will operate the machines of a large factory without requiring the expenditure of large sums for shafting and belting and for coal for driving them.

A WONDER IN CATALOGUES.

For several months past the Metropolitan Electric Company of Chicago, have been bending their energies to the preparation of a catalogue which should fairly represent to their friends and customers the multitude of varied appliances which they carry in stock and which they are prepared to furnish upon call. Now that the publication has been issued it requires no stretch of the imagination to realize what an undertaking the preparation of such a work has involved. The Metropolitan Company call it an enclycopedia and it is very appropriately named. The proverbial expression "from a needle to a haystack" might be modified in this particular connection to read "from a fuse to a dynamo or a steel range," and if there is anything that by chance may have been omitted from the list, the Metropolitan is prepared to supply it any way.

An idea may be partially formed of the volume of matter in this catalogue when it is known that it contains upwards of 750 pages 8x11 inches in size. Every page is illustrated, too, with from one to a dozen cuts. But there is a vast amount of information in the catalogue besides lists of articles and prices. Every article is described in detail and there are tables and tables: some give the carrying capacity of wires, others for calculating speed of pulleys—but to enumerate all would be useless, the catalogue must be seen to be appreciated and no one engaged in any branch of the electrical business can afford to be without it. It is thoroughly indexed and any article wanted can be found at a moments' notice. The conditions upon which a copy of the catalogue may be obtained can be found in the advertisement of the Metropolitan Company upon the back outside cover of this Journal.

THE AMERICAN MOTOR LEAGUE.

During the Motor Vehicle contest in Chicago a movement has been on foot, and is now perfected for the establishment of a permanent organization to be known as THE AMERICAN MOTOR LEAGUE. All persons interested in the advancement of the Motor vehicle are eligible to membership. The purposes of the League are to advance the interests of the horseless vehicle in every way; by aiding and directing legislation: by protecting the users of such vehicles against prosecution; by encouraging the institution of contests; by holding meetings where scientific papers on the subject may be read, etc. The League starts out with a membership made up of practically all those who have been engaged in the recent contest as manufacturers, and a number of others interested as users, or prospective users. The meeting at which permanent organization was effected was held in the lecture room of the National School of Electricity, 335 Dearborn street, Chicago, on the 29th of November.

The following gentlemen were selected as vice-presidents: H. D Emerson, Cincinnati; Henry G. Morris, Philadelphia.

Mr. Charles B. King, of Detroit, was elected treasurer.

Mr. J. Allan Hornsby, of the ELECTRICAL JOURNAL and the National School of Electricity, was elected permanent Secretary.

All who desire to become members will send their applications with three dollars—two dollars for initiation and one dollar for annual dues—to the secretary J. Allan Hornsby, 335 Dearborn Street, Chicago, and a card of active membership will be forwarded to them.

On the morning of Nov. 30th the Executive Board elected Mr. Charles E. Duryea, of Peoria, Ill., President.

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CONTEMPORANEOUS COMMENT.

TREATS POWER COMPANY LIKE CONFIDENCE MEN.

The Common Council has never shown a proper disposition on the Niagara power question. There has been a spirit from the beginning that the company was an intruder and that unless it did precisely what the members of the Council dictated it couldn't distribute power here. Recently this spirit was somewhat justified by the company's unexpected declination of the five per cent. proposition after the understanding had been reached that this rate of percentage was satisfactory. The press of the city without exception condemned the company's action.

Apparently certain members of the Common Council feel that this censure of the company carried with it general opposition to the plan of admitting Niagara's energy. The old disposition to treat the company's representatives as confidence men is again showing itself.

Let the representatives of the company and those of the city as the Times said several days ago, meet as business men and arrange the language of the contract so it will not be capable of a double interpretation. The question of percentage can be settled afterward. The city and company can get together on that proposition.—*Buffalo Times.*

ELECTRICITY ON THE BROOKLYN BRIDGE.

Sometimes the delays on the Brooklyn Bridge caused by a break in the cable provoke complaint from the people and they hope that some system not liable to breaks will be used. It is well now and then to remember the advantages which the cable offers. If the trolley system, for instance, should be used on the bridge the only guarantee against collisions would be the intelligence of the motormen. That intelligence, however, would not avail when the tracks were covered with ice and the trains began to rush down the grade on either end as a toboggan rushes down the icy slide. Brakes would be useless in such an emergency. It requires little imagination to conceive the disastrous result following the arrival of an uncontrollable train at the station. It is not probable that the bridge trustees will decide to change the motive power on the bridge itself until they find a system as safe as the cable. The use of electricity instead of steam for switching purposes would not affect the situation on the span. Electricity is as safe as steam in the stations. It is not as safe as the cable when the trains are run over the bridge less than a minute apart.—*Brooklyn Daily Eagle.*

WANTS THAT NIAGARA CURRENT.

In a double-leaded article the Evening News makes the following remarks: "There is evidence of a systematic effort to defeat the final adoption of a franchise permitting the bringing of Niagara power into Buffalo. This may be done in the interest of a socialistic scheme of municipal ownership or it may be predicated on the easy theory that whatever a corporation does or has is a legitimate object of attack. Whatever the motive, the socialists and communists are at work." We do not understand what this means, but it prompts the repetition of the suggestion that the manufacturers and other business men of Buffalo should long ago have made a systematic effort to settle this question. Instead of doing so they have allowed things to drift month after month and have apparently been as indifferent as they would be were they dwellers in Patagonia. It has been and is an extraordinary spectacle.—*Buffalo Courier.*

DOES NOT FAVOR MUNICIPAL CONTROL.

We ourselves are, and ever have been, in favor of restricting municipalization within the narrowest possible limits, on the ground that jobbery will inevitably creep in, and that the emulation of municipalties is not, in plain business matters, an adequate substitute for the competition of companies.—*London Electrician.*

DANGER OF TOO MUCH SHELTER.

The story of the motorman who ran his car into an open draw at Cleveland is the first instance on record that appears to corobborate the theory that it would not be safe to enclose the motorman's platform. His platform was enclosed, the night was wet, the glass was misty, and he was unable to see the danger signals There are two answers to this: First, it was the conductor's business to go ahead of the car at this place and give the motorman special signals, as he did; and second, if there was danger to be apprehended, the motorman should have had his window open, so that he could have seen his way clearly. What would be thought of a locomotive engineer who would shut himself up in his cab and neglect to look out for signals because the glass was misty? *Philadelphia Public Ledger.*

INSISTS ON REGULATION OF SPEED.

We observe that the Mayor and the Corporation Counsel are much interested, seemingly, in the concoction of a new fender ordinance to prevent the killing or maiming of any more citizens by the trolley cars. In point of fact, no importance is to be attached to anything they may do under this head. Its only real purpose is to withdraw public attention from the one thing that is absolutely necessary to secure safety on the public streets, and that is the regulation of car speed.—*Brooklyn Citizen.*

WANTS CARS ELECTRICALLY HEATED

Surface cars in Cleveland, Ohio, and such small places as Aurora, Ill., and St. Joseph, Mich., are heated by electricity; and here, where the cars are run and lighted by that agent, the car stove is still found, although the single current required to operate the cars is sufficient to do that and light and heat them, too.—*Brooklyn Citizen.*

DOMESTIC USES OF THE BATTERY.

M. W. deFonveille in L'Etincelle Electrique for November 5, discusses the domestic applications of the electric battery. He suggests the lighting of country mansions by means of storage batteries, the performance of galvano-plastic operations, electroplating, the application of electricity to the lighting and service in hotels and restaurants, electric clocks, call-bells, annunciators, etc., the various fire and burglar alarms, and above all the influence of electrical appliances and illusions upon the superstitious minds of peasants and savages who would consider such manifestations as supernatural. The author suggests that by means of the battery a French family might live in safety even in Madagascar, Dahomey or Tonquin and cites examples of Algeria and Tunis in support thereof. He goes further and describes a method of defense by a system of electric protection whereby marauders would receive painful or dangerous shocks upon touching the fences, door-knobs, etc. In India electric fans might be substituted for punkahs or fans used by the princes and nabobs.

NEW STYLE OF STREET CAR.

The Cincinnati Street Railway Company has built and put into service a combination street car which is a diversion from the type in general use on street railways, though something of the same pattern has been in use in Denver and one or two other places for some time. The car is mounted on two bogie trucks with a motor for each. One axle of each truck carries a motor and the driving wheels are larger than the ordinary size. The other wheels of the truck are comparatively small. The body of the car is divided into two sections, one part being open as in the summer car, the other closed in. This arrangement gives passengers the option of riding in the close, stuffy atmosphere that usually pervades closed cars, or riding in the open section where Jack Frost can make merry with them. Passengers pay their fare and take their choice. If this experimental car proves the success that is anticipated for it, a large number of additional cars will be constructed.

The subscription price to THE ELECTRICAL JOURNAL is $2.

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HERE, THERE AND EVERYWHERE.

Light and Power.

The question of establishing a municipal lighting plant is being earnestly agitated by the people of St. Paul.

Lowell, Mass., has the municipal lighting fever, and a committee has been appointed to look into the matter and report.

The Electric Light Company of Petersburg, Ind., has had to sue the town trustees for an account of $1,000 for services rendered.

It is expected that by the opening of navigation on the Erie Canal next year that at least twelve miles of the route will be equipped with the electric towage system.

The Niagara Falls Power Company has closed a contract with the Acetylene Gas Company for 10,000 horse power. Of this total 1,000 horse power is to be delivered January 1.

The Mutual Electric Light and Power Company operating in Chicago, has assigned with liabilities of $25,000. The reason given for the failure is insufficient patronage and its inability to meet its obligations.

Lake City, Fla., has awarded a ten-year lighting contract to the Lake City Water & Light Company, and the latter is asking for bids for a 50-light alternating dynamo, wire, lamps, and other attachments. They will want also a 75 or 80 h. p. engine.

On the Anspach Memorial in Brussels which represents St. Michael on horseback slaying the dragon, the sword will be made to blaze like a sword of fire by the use of the electric light, while lights will also be in the Saint's eyes and in the insides of the dragon.

St. Paul, Minn., hopes to arrange for a system of municipal lighting by which it is figured that they can not only save $50,000 to $60,000 a year, but that in addition they will be able to relieve the city from the odium of being one of the worst lighted cities in the Union.

The Elgin Electric Illuminating Company has been notified by the General Electric Company that it is infringing on the latter's patent by using the bridge circuit around a single dynamo and transferring switch. The Elgin Company denies this, and asks for an investigation.

New York State Electrician Barnes states that he is well satisfied with the system of electric towage inaugurated on the Erie Canal, and is certain that it will prove a great success. "There are a few minor details yet to be perfected," he said, "but they are of small importance."

The Niagara Falls Power Company has called for bids for the extension of the power house and wheel pit so as to accommodate seven more 5,000 h. p. dynamos. This extension will give the company a capacity of 50,000 horse power. The work will be completed in about six months time.

The local electric lighting company of South Bend is charged with furnishing lights under the required candle power, and have pleaded in extenuation, their inability to get wire. The council recently adopted a measure to help them out of their difficulty, which can hardly fail to have the desired effect. Until the service is improved no further payments will be made for any service rendered.

From the Battery to Fourteenth Street in New York, total darkness reigned supreme a few evenings ago from dusk until midnight, due to a break down at the electric lighting plant. The papers, alarmed by the fact that such an accident gives to the unruly class increased facilities for commiting depredations, are demanding that measures be taken to obviate the possibility of such an event occurring again.

A motocycle in the business part of town scared a dozen or more teams of horses last Tuesday. In one respect the horse is greatly inferior to its mechanical rival. A hundred horses couldn't scare a motocycle.—*Chicago Tribuue.*

Railways.

Fergus Falls, Minn., has issued bonds to the amount of $25,000 to provide a fund for the building of a municipal lighting plant.

The Chicago, Burlington and Quincy Railroad has adopted the automatic electric block signal system on that portion of their road running between St. Louis, Mo., and Alton, Ill.

The General Electric and the Westinghouse Companies will each experiment on the Brooklyn Bridge with a train electrically equipped to demonstrate the practicability of their respective systems for switching of trains.

The second of the three great electric locomotives ordered by the Baltimore & Ohio railroad has been delivered. This engine is exactly like the one that has been performing such satisfactory work in the Baltimore tunnel.

An electric railway is at present under construction between Baltimore and Washington. The speed of trains called for by the contract is sixty miles an hour. The motor car system is to be adopted, and the coaches will resemble those in ordinary use on steam roads, only somewhat lighter in construction.

What is known as the Union Loop Line in Chicago, has aroused a vigorous opposition among the property owners on the streets where the line is intended to run. The purpose of the loop line is to unite the three systems of elevated roads, the Metropolitan and Lake Street lines from the West Side and the Alley L on the South Side. The line will run along Wabash Avenue and down Van Buren, unless some obstacle presents itself to the carrying out of the plans. The Wabash Avenue property owners have already carried the case to the courts and have been defeated, and now the Van Buren Street proprietors are leaving no stone unturned to frustrate the designs of the railway company. Meantime the laying of foundations is being progressed with along Wabash Avenue, and the expectation is that the company will carry its point, and that the line will be completed at an early date. The loop line will enable patrons of the several lines to get much nearer to the heart of the city than at present, and is an improvement which in the public interest ought not to be delayed any longer than is absolutely necessary.

General News.

The recent storm in Chicago caused damage to the fire and police wires of the city, to the extent of $10,000.

Cincinnati has caught up with the van of progress and established an electric mail car service for gathering mail throughout the city.

The electrical interests of Des Moines, Ia., have petitioned the city council for an ordinance to regulate wiring and the installation of apparatus.

Since the opening of the Brooklyn Bridge, 391,111,526 passengers have been carried across it, and the two men killed a few days ago by a collision, mark the first fatality. It is a wonderful record, and speaks well for the management of the bridge.

Owing to a phenomenal increase in the business of The Electric Storage Battery Company, the Chicago office has had to acquire more commodious quarters, and on December 10 will remove from their present location, 309 Dearborn street, to the fifteenth floor of the Marquette building.

The Electric Light and Traction Company, of St. Joseph, Mo., is laying pipes for a system of heating by electricity The present territory embraces about half a mile square in the center of the city. If the method proves a success an extension will be made to include private houses in more distant parts of the city.

A suit has been entered by the Ansonia Company against Hugh McMillan, of Detroit, for the payment of a $5,000 debt contracted by the Detroit Electrical Works, on the ground that Mr. McMillan represented the company as solvent when, as a matter of fact, it owed over a million dollars with not enough property on hand to realize more than $100,000.

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ELECTRO-THERAPEUTIC DEPARTMENT.

SOLUBLE ELECTRODES.

Have Greater Antiseptic Power than Non-Ozydisable Electrodes—Destructive to Bacteria.

Under the name of Interstitial Electrolysis of Medicamental Electrolysis etc., I made known three years since, a method of treatment susceptible of numerous applications.

Struck with the fact that the continuous current of therapeutic doses had no action of itself upon microbes; that the positive pole might be antiseptic by reason of the substances which form therein, I asked myself if it were not for the interest of clinical applications (as often at least as the end aimed at was antiseptic) to search out the method which would furnish the most antiseptic anions, knowing that the nascent electrolytic products would penetrate into the depths of the tissues.

In 1891 Prochownick and Spaeth of Hamburg demonstrated that the bactericide product of the anode holds in its chemical modifications chlorine and oxygen in case of a platinum electrode, or bichloride of copper in case of a copper electrode.

This action of the products formed at the positive pole being demonstrated by these authors and by others M. M. Vilato Laguerriere and Apostoli the question arises, is the antiseptic power greater in non oxydisable or in soluble electrodes?

My experience enables me to assert the antiseptic superiority of the copper electrode and of the electrolysis of ioduret of potassium.

My experience shows:—

1st.—That the continuous current produces a bactericide effect in consequence of the transformations of the electrolyte in connection with the anode.

2nd.—That soluble electrodes are the occasion of these transformations and constitute electrolytic applications at option.

Later M. M. Enrico Burci and Vittorio Frascani have succeeded in verifying these facts and in showing by a series of demonstrations better established than my own "that the iodine which is developed by the electrolytic action of the continuous current in solutions of ioduret of potassium has a destructive power with small and sometimes with very small intensities, that it has recently been brought to bear on the staphylococcus pyogeneus aurens, upon the streptococcus, on the bacillus urea and upon the spores of the anthrax, etc."

In a very remarkable medical treatise by Dr. Albert Eveil entitled "The continuous current in gynaecology" the author analyses all the works which have appeared on the antiseptic actions of the continuous current.

M. Eveil admits that the medical continuous current is for the bacteria neither a tonic nor a poison: it does not modify them. Their only poisons are the chemical products which are disengaged from the positive pole.

"If the electrolysis of the ioduret of potassium" says M. Eveil "permits as to sterilise cultures the electrolysis which leaves as secondary products oxychloride of copper may pretend to the same result more easily than the electrolysis of a bouillon with nonoxydisable electrodes. M. M. Apostoli and Lagnerriere insist on the necessity of high intensities to this end, claiming that it is not a matter of indifference to diminish the intensity in order to prolong the duration and vice versa: how can we reconcile this contradiction with the law that demands that the quantity of the body decomposed shall be proportionate to the chemical equivalent, to the intensity and to the time, since the antiseptic power of the positive pole depends solely on this quantity.

"The positive pole is then antiseptic" continues M. Eveil" and since its value is measured by the products which form therein would not the same results be obtained by the action upon the tissues affected of solutions containing these products."?

"In microbatic affections of the genital organs of woman the bacteria do not attack the surface of the mucous membrane, they are deeply seated in the glandular crypta and surely a method which facilitates the entrance of an antiseptic within these follicles would be preferable to another method where the bactericide action only takes place on the surface: * * * With the positive pole intra-uterus one would have the ioduret of potassium and the iodine carried through the mucous membrane of the uterus if the electrolysis were made of the ioduret of potassium and the oxychloride of copper if the electrode intra-uterus were of copper. * * * M. Gautier has proved these cataphoretic phenomena after having for 10 minutes caused the positive copper pole to act with an intensity of 20 milliamperes on the interior of the uterus of a rabbit; he has proved that the muscular tissue was penetrated by the oxychloride of copper and that the external region showed the characteristic green. * * * The experiences of M. M. Burei and Frascani the author concludes "show that in a case of erysipelas in the ear of a rabbit they had obtained better results by the electrolytic introduction of iodine than by immersion in a bath of sublimate.

I am desirous in this present assembly to fix the attention of my audience upon the theoretic value of soluble electrodes and especially upon the superiority of their bactericide results.

The use of soluble electrodes shows a vast progress in electro therapeutics, above all in connection with gynaecology and at your approaching meeting I will preset you with my own works on the subject.

*Paper by Dr. Gautier, of Paris, read before the Toronto Convention of the American Electro-Therapeutic Association, September 5, 1895

SALPINGO-OOPHORECTOMY.

Results of Electricity in After-treatment of Cases Not Relieved by This Operation.

Dr. E. Sanders, of New York, in a well-written article in the American Journal of Obstetrics for September and October 1895, discusses the effects of electricity in cases where the removal of the uterine appendages had failed to relieve the sufferings of the patient. The local application of electricity gives relief to a certain proportion of these patients, and actually effects a permanent cure in a few cases. Of course some of the patients will not derive any benefit at all from the treatment. When actual secondary changes exist within the pelvis following the operation, and this occurs in a majority of the cases, relief is possible, anp cure may even be effected when these changes are not too deep-seated and profound. When, however, these morbid changes have existed prior to the operation, little is to be hoped for from electricity.

Electricity was tried in twelve instances where local lesions were detected, which seemed to be dependent upon the preceding operation, and the author cites four cases showing various forms of operative sequelae, as an index to the results of electricity in such cases.

The first patient suffered from post-uterine tenderness as the dominant symptom. Six months after the operation the use of galvanism was begun, the positive electrode being a clay ball within the vagina and behind the cervix, and the negative electrode a pad over the abdomen. The strength of current employed was from 45 to 65 milliamperes, given for five to seven minutes. From the very first, improvement was noted, and in less than three months she felt perfectly well and treatment was discontinued. Six months later she had had no return of the symptoms.

The second patient had had four years previously a cyst of the right broad ligament and the left ovary and tube removed, without relief. She complained of pain in the back and left side. On examination a elongated, sensitive mass, the size of two fists, was found attached to the left side of the uterus. Various measures had been tried without success, and at this time the patient was in a deplorable condition, with marked emaciation, loss of appe-

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tite, and disturbed sleep, so that life as she expressed it, was not worth the living.

During three months she received sixteen applications of galvanism. The positive electrode was introduced into the vagina up to the vault on the left side, being replaced by the negative when the greater part of the pain had been overcome. The current varied from one hundred and twenty to one hundred and sixty milliamperes. After the fourth application the pain had almost entirely disappeared, and the mass was softer and had decreased in size. The improvement continued and at the end of treatment the mass had entirely disappeared and the patient felt perfectly well. Three months later she returned for treatment, on account of a recurrence of the pelvic pain due to strain. Examination revealed an exudation mass the size of a fist in the old location. Galvanism, but with a lower amperage was employed, and in a month all signs of exudation had vanished.

The third case was one of excessive tenderness along the left side of the uterus and the right tube, which had persisted for six years and a half after removal of the left ovary and tube. The patient remained under treatment for more than a year. Galvanism was at first given with the positive, clay-ball electrode in the vagina; later on, the positive platinum electrode was was used in the uterus with the idea of curing the co-existing endometritis. From fifty up to one hundred and fifty milliamperes of current were administered, with resultant abatement of pain and tenderness. The Faradic current was also tried, but seemed rather to aggravate the symptoms. A year later, she had grown stout and rosy, but still had at times pain on the left side, not to be compared in severity to her former sufferings.

The fourth patient had had both tubes and ovaries removed at two operations. She stated that the operations had given her no permanent relief, and complained especially of pain in the lumbar and sacral regions, with exquisite suffering on defecation. She also had the ordinary nervous manifestations, flushings, flashes of heat, irritability, depression, etc. Examination showed left later oversion of the uterus and a soft, flat, movable mass the size of an English walnut, extremely sensitive to pressure, on the right side of the pelvis. The plan of treatment consisted in galvanism, the positive electrode in the vaginal vault at first, and later on, the negative. The negative electrode was at first placed anteriorly over the lower abdomen, and later on, when the mass had decended into Douglas' pouch, over the sacrum, the object being to pass the current directly through the offending mass. Low current strengths were at first employed, but later on as high as two hundred milliamperes were given. The pain disappeared and now only occasionally recurs, and is relieved by a single application of galvanism. The Faradic current was resorted to, but without result. Cataphoresis was also tried with cocaine; the result was satisfactory as far as the pain was concerned, but the cocaine caused unpleasant symptoms which necessitated its discontinuance. Cataphoresis with a ten per cent. watery solution of ichthyol, was also tried with equally good results and without unpleasant sequelae. The patient remained under observation for nearly three years, during which time she received eighty-eight applications of electricity. The sensitive mass still remains, but the patient's condition has vastly improved, so that she can do her own housework, while defecation is no longer painful.

The author reports that in the twelve cases he has treated, painful defecation was the dominant symptom in five cases, epistaxis in one, and dyspareunia in two, while abdominal hernia was present in two cases. The results in these twelve cases were cure in two cases, more or less permanent relief in four, transient relief in three, absolute failure in two, and in the remaining case treatment was abandoned too early to demonstrate any result, and it will thus be seen that in one-half the cases more or less permanent relief followed electrical treatment.

The author urges that electricity and especially galvanism be resorted to in these deplorable cases of operated, yet uncured salpingo-ovarian disease, as some may be cured, others relieved, while some will unfortunately remain unbenefited. The treatment, even if it does no good, does no harm, and is of benefit in the great majority of cases.

ELECTROVITERATORY MASSAGE.

Under the above title, Dr. W. Freudenthal, of New York, describes in the New York Medical Journal an instrument devised by him for use in cases in which massage of the ear, nose or throat is indicated. The conditions essential to successful internal massage are extremely rapid vibrations at regular intervals and of the same intensity. Dr. Freudenthal claims that his electro-vibrator fulfills these conditions. He describes his instrument as follows:

Two magnets occupy the interior of the box. Around these magnets coiled wire runs in manifold windings. Between these two magnets a rod is placed destined to move forward and backward; at its rear end an iron plate is fastened, and to this is attached a movable metal plate. To the front end of the rod is screwed a detachable part, or probe, the button of which is movable. The index finger slips into a holder which is attached to the neck of the instrument, the box resting between the thumb and the index finger of the operator. Two little screws at the lower part are points of attachment for the electric wires. On the neck is placed a metal spring which holds an ivory button. When this is pressed upon by the tip of the index finger, the current is closed and the iron plate is drawn forward by the magnet, which at the same moment has become electro-magnetic, and, as a matter of course, the rod holding the probe is drawn forward also. As soon as the iron plate has reached its foremost point, the contact is interrupted directly before the screw, and the iron plate falls in its original place, driven by spring power. The next instant the current closes again, and the mechanism repeats itself over and over. The quantity and quality of the vibrations are regulated by a set of screws attached to the rear of the box.

This instrument, the author states, can be used without practice or especial dexterity.

PESSIMISM IN ELECTROPHERAPY.

Professor F. Schultze, Director of the Polyklinik at Bonn, and for a long time associated as electrotherapist with Professor Erb, has published a monograph upon the curative action of the electricity in affections of the nerves and muscles. In this brochure he states that in these affections, electricity, as ordinarily applied, has had a very limited field of usefulness and especially so in organic destructive affections of the central nervous system. Although these conditions cannot be cured, the condition of the patients may be ameliorated. In like affections of the peuptreral nerves, the more rapid curative result by electricity is not improbable but it is not yet demonstrated.

Functional diseases of the nervous system are more favorably influenced by electricity, but in these cases the physical element is an important factor. This is particularly true of the cases in which hysterical symptoms are present. Neuralgias, myalgias and weakness of organs having smooth muscular fibre may be curable by electricity; but severe neuralgias are only exceptionally improved and often far more readily by other remedies.

Professor Schultze therefore concludes that the line of indications for the use of electricity as a therapeutic measure should be drawn more closely than was the case when electrotherapy first arose. It is not detrimental to any remedy to speak freely and without prejudice as to its capacity, for by this means new remedial measures are disclosed and investigations are made into the causation of disease instead of trusting blindly to one single remedy which too often fails.

The Paris Municipality has granted the sum of $4,000 for the erection of a building for the treatment of mental and nervous diseases by electricity, in connection with the Salpetriere Hospital. This is a recognition of the value of electricity in the healing of disease that would have been impossible even five years ago.

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

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JOHN FREDERICK DANIELL.

Eminent Chemist and Physicist. Born in London 1790. Died 1845. Inventor of the Sulphate of Copper or Constant E. M. F. Voltaic Cell bearing the inventor's name.

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The Electrical Journal.

Vol. I. CHICAGO, DECEMBER 15, 1895. No. 14

CRITICISM OF TROLLEY HURTS.

Yerkes Resents City Electrician Barrett's Opposition to Overhead Trollies—Retaliates by Talking Nonsense About Municipal Lighting.

HIS CHARGES ARE PROVED TO BE UNFOUNDED.

Mr. Yerkes, Chicago's street car magnate, and Mr. Barrett, Chicago's city electrician, through the friendly aid of the press, have recently been engaged in a spirited controversy over the administration of their respective interests.

Mr. Barrett, for many years strenuously opposed the stringing of over head wires in the business district of the city, first, because of their unsightliness, and again because of their interference with the fire department in the discharge of its duties, and had succeeded after long and continued effort in getting the greater portion of them underground, when the street car companies began to weave a net-work of trolley wires along the down-town crowded streets. This not only undid the work of years, but aggravated the nuisance ten times over. Not only were the trolley wires and posts unsightly in the extreme, but they were also a source of constant danger by reason of the heavy current which they carried. Mr. Barrett had long contended against the introduction of the overhead trolley and is somewhat chagrined that, contrary to his judgment and advice, the railway companies have been permitted to string their wires right in the heart of the business center where the streets are both narrow and crowded.

It was while he was in none too pleasant a frame of mind on this subject that the recent snowstorm came and verified his worst fears. Laden with sleet and snow, telegraph and telephone poles and lines went down in all directions, carrying trolley wires with them. As they crossed each other the dangling wires became charged with the dangerous current of the trolley and not only presented a menace to the lives of the people, but destroyed many thousands of dollars worth of property in the shape of burned-out appliances belonging to the telegraph and telephone companies and to the City of Chicago. To such an extent did it affect the city that communication was almost entirely cut off between the different fire stations, and had a serious fire been started the consequences might have been a costly lesson to Chicago.

These were the conditions that prompted Mr. Barrett to urge, as he had done before, the use of some one of the several systems of underground connection for railway purposes, but in doing so he said something that roiled the ordinarily sweet disposition of the street car magnate. Mr. Yerkes has had things so much his own way in Chicago that for anyone to oppose his interests in any direction, immediately sets his feathers all on end and the interference is regarded by him as the height of presumption; so he undertook to retaliate upon Mr. Barrett by giving vent to what he thought he knew about the cost of municipal electric lighting in Chicago. He made the charge that it cost Chicago more for its lights than was paid by any other city in the world and incidentally blamed Mr. Barrett for it. That he did not know what he was talking about is apparent from the latter's reply as set forth in an interview published in the Chicago Evening Post of December 9.

COST OF MUNICIPAL LIGHTING.

"In reference to the cost of municipal lighting in this city, I will say that my annual report for the year ending December 31, 1894, shows a cost per lamp per year of $96.67. The lamps are operated every night from dusk until daylight and the cost per lamp per hour is .0244. Municipal lighting in this city was started on a small scale, the council appropriating enough money to place 105 lamps on the bridges and viaducts and an engine and three dynamos in the basement of a fire engine house. The second appropriation gave us enough money to place 300 additional lights on the streets and a larger engine with the necessary number of dynamos in another fire engine house. With the third appropriation, land, buildings and machinery were acquired and main subways built, having a capacity of nearly three times the number of lights which we are using to-day.

"To the cost of operating our lights the enemies of municipal lighting add for interest, depreciation, water taxes, insurance rates, etc., sufficient to bring the price up high enough to suit their purpose and show that as the cost of Chicago's street lights.

GETS BACK AT MR. YERKES.

"Mr. Yerkes makes comparison between cities where private corporations furnish the city lights and Chicago, and says that there is no city in the world that pays so much for public lighting and as little for private lighting as Chicago. I can only say in answer to this, that Chicago is getting her street lights at their actual cost, while in cities where corporations are furnishing street lights at a low cost, the difference is charged up to the private consumer, who consequently pays more for his lights than is paid for similar lights in Chicago.

"Everything in the shape of franchises which Mr. Yerkes has so far requested of the City of Chicago has been given him, and perhaps if his management is considered so good it would be the proper thing to turn over the police and fire departments, public works, fire-alarm telegraph, water department and other departments at present operated by the municipality to some private corporation under his management.

MUNICIPAL LIGHTING ELSEWHERE.

"To return to the question of municipal lighting. In New York the city rents 1,674 arc lamps at 40 cents per night each, which is at the rate of $146 per annum; 922 lamps at 45 cents per night each, which is at the rate of $164.25 per annum; 154 lamps at 50 cents per night each, which is at the rate of $182.50 per annum; the power of the lamps being about 1,200 candles, usually called 2,000 candles, and they being lighted all night and every night—a total of 3,959 hours per year.

"In Brooklyn the city rents 2,641 arc lamps at 35 cents each per night, which is at the rate of $127.75 per arc lamp per annum. The nominal candle power is 1,200 and the lamps are operated under a schedule which provides for about 3,900 hours of electric lighting for the year.

"In Boston the city rents 2,397 arc lamps at the rate of $127.75 per arc lamp per annum. The park lamps on the underground system, owned by this city, are furnished at the rate of

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$124.10. The nominal candle power of these lamps is 2,000, and they are lighted each night from sunset to sunrise, or 3,828 hours per annum.

"In Philadelphia the city rents 6,221 arc lamps at an average rate per lamp per annum of $151. It does not contract for candle power, but for amperage and voltage. Lamps burn from sunset to sunrise every night in the year. I should judge that in Philadelphia the amperage and voltage would probably be about what we call a 2,000 candle power lamp; certainly not to exceed that candle power.

COSTS LESS IN CHICAGO.

"From these facts it can readily be seen that our figures obtained this year for rented lights as well as our average cost for the last two years for operating and maintaining from 1,102 to 1,110 arc lamps at $96.67 per arc lamp per annum are below those of any of the cities mentioned so far as cost is concerned, and the candle power is in excess of that used, in part, at least, by some of the above cities."

POSTAL TELEGRAPHS' NEW QUARTERS.

Chicago Office Moved to the Stock Exchange Building—Elaborate Appointments.

The Chicago branch of the Postal Telegraph Company has just moved into most desirable quarters in the Stock Exchange Building. Indeed, it is claimed that the office is now the best appointed and most luxuriously fitted of any in the world used for like purposes. The operating room alone embraces 6,000 square feet and there is room to spare which will admit of doubling that capacity. Thirty octet tables in cherry provide accomodation for 240 operators and are so designed that they store away eight typewriters in each table. It has been made a feature of the office that the pen and pencil shall be entirely abolished.

The electric currents necessary for the operation of the large system of wires connecting Chicago with the outer world are generated by motor dynamos, which are located in the basement of the building. Each motor dynamo is a double machine; the motor part being driven by electric current from the large building dynamo, causing the dynamo part to yield a current of a certain polarity and electromotive force for the telegraph wires, which require several different voltages, as well as polarities of current. There are twenty-three of these motor dynamos, ranging in power from thirty-five to 400 volts, making a complete duplicate plant. In case of failure of any one machine, another of the same power is always in readiness to take its place.

Upon the large marble switchboard, near the dynamo plant, are placed the switches and rheostats necessary for the proper government of all these machines, and the wiring is so arranged that each machine is entirely independent of the others; thus, at will, any or all machines comprising the plant may be put in service.

The transfer of the wires from the old to the new quarters, performed between the hours of 2.30 A. M. and daylight, was a feat which reflects credit upon the management. Thousands of wires were cut and thousands of new connections made, but so perfect were the plans that there was not the slightest hitch or interruption in business.

HEATING BY ELECTRICITY.

The Carmelite Monastery at Niagara Falls, Ont., is trying an experiment in heating by electricity, which will be watched with interest, says the Canadian Electrical News. The whole building will not be so heated, but having arranged for a fixed amount of power, all of which is not required for other purposes, the surplus is to be employed for heating. Electricity is not an economical agent for heating so far, and is used on street cars on account of its convenience, and because the current cuts no figure in the railway's expense account. But it will be employed at the monastery under favorable conditions, and the result will be of service in arriving at the relative cost as compared with other methods.

WATER RHEOSTATS.

Mr. George T. Hanchett says that many practical men do not know how universally water resistance may be applied, both for temporary and permanent service, in electric lighting and power work. It is often the case that a resistance of some kind is greatly desirable, if not absolutely necessary, and a few practical suggestions concerning the use of water resistance in such cases may not, he thinks, be amiss. The fluid in a water rheostat is not wholly water, as the name might imply, but consists of a mixture of water and some acid, usually sulphuric, which is added to vary the specific resistance. As the range obtainable by this procedure extends from one-tenth of an ohm, or even less, to several thousand ohms, the flexibility of the device is obvious, and it is practicable to prepare a water resistance to suit any voltage by varying the degree of acidulation. In the liquid are placed two terminal pieces, identical as to material, so as to obviate electrolytic action, and to these are attached the current wires. The proper shape and size of these terminals depend upon the volume of current to be passed through the device, and are also effected somewhat by the voltage. With large currents or very low voltage, or both, the terminals should be of large superficial area, and conversely. Water resistances are more often temporary devices, and therefore barrels, pails, etc., are frequently pressed into service. In cases where the apparatus is to be used for a few moments only, and the voltage is not dangerously high, a metal vessel is very convenient and satisfactory, the vessel itself constituting one terminal, and the other terminal being suspended therein. The resistance is decreased by gradually lowering the suspended terminal until it touches the bottom of the vessel, when the resistance is, of course, entirely cut out. However, it is not desirable to use any device in which the terminals come together, except in cases like the one just mentioned, for the sudden removal of resistance from the circuit, caused by the accidental dropping of the suspended terminal, might result disastrously. A water resistance may be adjusted either by varying the distance between the terminals or by varying the terminal area submerged. The first method is preferable with heavy currents, and the second is better with small ones. The bulk of fluid necessarily depends upon the watts to be absorbed, regardless of voltage and current. For a steady load, free from sudden fluctuations, 20 kilowatts per barrel of fluid will be found to be a very satisfactory working figure. Experiment is usually the better way to determine how much acid is necessary, but for those who desire a guide to follow, the following table is given:

RESISTANCE OF A LIQUID ONE SQUARE FOOT IN CROSS-SECTION AND ONE FOOT LONG.

Pure water	about 100 Ohms.
.174 per cent. acid	4.12 "
.435 " "	1.75 "
.724 " "	1.10 "
.985 " "	85 "

The proportion of acid should be sufficient to enable the solution to absorb about one-third the desired energy. The rest can readily be obtained by the adjustment of plates. In some cases, where a high voltage and a very small current are involved, as in voltmeter circuits, a water rheostat in column form will be found to give satisfactory results. Unfortunately, water resistances are prone to develop back E. M. F.'s., which preclude accurate measurements. To avoid this as far as possible in voltmeter circuits, a solution of zinc sulphate and two zinc terminals should be used. These, Mr. Hanchett says, produce a minimum back E. M. F.—*London Electrical Engineer.*

A Quebec paper prints the following extract from the records of the proceedings of the Sacred Congregation of Rites, of Rome, June 4, 1895: "Question. May electric light be used in church? Answer. For purposes of worship, no; but for dispelling darkness and more brilliantly illuminating the church, yes; but care must be taken that the manner of illuminating shall not resemble a theatrical spectacle."—*Canadian Electrical News.*

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STUDY OF THE HOLTZ MACHINE.

Its Mechanism and the Principles of its Operation Clearly Described.

The following paper has been submitted in regular course of study by Mr. W. P. Thornton, a student in the Chicago Laboratory of the National School of Electricity:

The object of this experiment is to familiarize the student with the use of influence machines and the principles involved in their action.

The only new apparatus used was the machine itself. Its construction is as follows:

In the accompanying drawings Fig. 1 shows a horizontal section of a portion of the working parts, namely the three glass

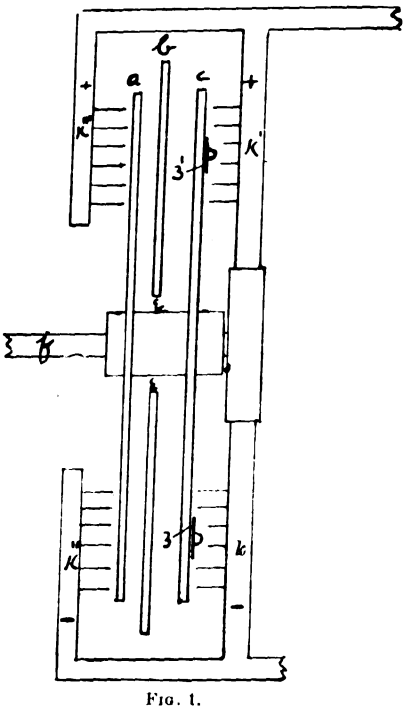

FIG. 1.

plates, the axle on which the two outer ones revolve, the four horizontal combs and rods connecting the same. Sections of two "carriers" are also shown.

Fig. 2 is a front view of the Holtz machine, with the base and part of the revolving mechanism omitted. Figs. 3 and 4 are enlarged details to be explained hereafter.

There are three glass plates, circular in shape, *a*, *b*, *c*; *b* is mounted vertically and stationary on supports *s* and s^1 upon a base not shown. Plate *b* is provided at its center with a circular hole, *e*, through which the revolving axis, *f*, passes without touching it. On the back of this plate are fastened two paper sectors *g* and g' of the shape shown. Between the sectors and plate are tin foil strips *h* and h' ending in circular disks t, t'', t', t'''. The disks *t* and t' are provided with tin foil arms t^4, t^5, which connect with small iron clamps i'' and i''', fastened to and supported by the plate *b*, which in turn are connected with and support bent metal wires *i* and i', which in turn are connected to and support small metallic brushes set in adjusting screws, the screws and brush being lettered together as *j* and j'. These brushes extend toward and nearly to the plate *c* and they are thus in metallic electrical connection with the strips *h* and h'.

The plate *a* is a plain circular glass plate somewhat smaller than *b* and of the same size and shape as *c*, and both *a* and *c* are at their centers suitably attached to the revolving axle *f* and turn with it in planes parallel to *b*. On the revolving plate *c* are attached six equi-distant carriers 1, 2, 3, 1', 2', 3', at such a distance from its center that they will pass over, and concentric with, the disks t, t'', t', t'''. They are approximately the same size as these disks, thin and circular in form, and each has extending from its center a small nub as shown in the sections of 3 and 3', adapted to strike the brushes *j* and j' (also *n* and n^1) as the plate revolves. Four combs, K', K''', K and K'', extend horizontally with their teeth toward the outside surfaces of the plates *a* and *c*, and the middle teeth of the combs extending toward the plate *c* are shortened to allow the nubs of the carriers to pass under them. The two combs on each side are metallically connected, and the combs on one side are insulated from the combs on the other. Connecting rods *w* and w' connect the combs of each side with the inside coating of Leyden jars *o* and o^1 and with discharging rods *p* and p^1 which have insulated handles and are adapted to be moved toward or away from each other. There are two binding posts *q* and q^1 each connected electrically, by a wire q'', q''', with the outside coating of the Leyden jars *o* and o^1. These posts are used for conveying away and utilizing when desired the charge repelled from the outside coating of the Leyden jars (caused by the induction of the inside coating). There is also a switch *z* adapted to turn at the point z^1 and which is connected by the wire z^4 with the outside coating of the Leyden jar o^1. The switch *z* is adapted to rest on or be removed from the nub z'' which in turn is connected to the outside coating of the Leyden jar *o* by the wire z^3. Rods *w* and w^1 are supported and insulated from a suitable base, not shown, and the jars, wires, switch and posts are supported in like manner, but their insulation is not so important. The switch *z* is adapted to connect them electrically when desired.

Across the center of the plate *c* extends a metallic conducting rod *e*, at the ends of which are combs *m* and m^1, similar in construction to the combs *K* and K^1 except that the center teeth are omitted and in their stead are inserted metallic brushes *n* and n', similar in construction to *j* and j^1. The comb, brush and its adjusting screw are shown in detail in Fig. 4.

The machine produces static electricity inductively. It is not self-charging, but when once charged it does not often lose its charge. Before its operation one of the sectors, for instance *g*, is charged with positive, static electricity by rubbing a glass rod with a silk cloth and then touching the connecting rod *i* (electrically connected with the sector *g*) with the charged glass rod. The other sector g^1 is similarly charged with negative static electricity by using a stick of sealing wax and woollen cloth instead of a glass rod and silk.

Let us first suppose the sectors have been charged through the rods *i* and i', *g*, positive and g^1 negative. The operation of the machine is as follows:

The plates *c* and *a* are rotated in the direction shown by the arrow. The carrier 2 passes under and touches the brush *j* and through the metallic connections receives a slight positive charge from the tin foil *h* of the sector *g*. The carrier and sector are now both positive. In this condition it passes up under the comb *K*, the positive electricity of the sector repelling the positive electricity of the carrier to the comb and its connections, and thence to the inner coating of the Leyden jar *o*; the positive electricity of the plate *c* is likewise repelled to the comb and its connections and thence to the inner coating of the Leyden jar *o*, all tending to neutralize the positive charge of the carrier and to render the surface of the plate *c* negative, and as the plate is a nonconductor it remains negative, the negative charge being induced by the sector *g*. At this time and after the carrier 2 leaves the comb, the sector *g* attracts its negative, and repels its positive electricity into its nub. Thus its inside surface is negative, its nub positive and the plate surrounding it negative.

During this portion of the operation the same phenomena, changing the signs of the charge, have occurred on the other side of the machine in the sector g^1 carrier and the plate *c* surrounding it, so that at this point the inside of the Leyden jar o^1 is charged negatively, the inside of the carrier 2^1 is positive, its nub negative, the plate surrounding it positive. The nub of the carrier 2 touches the brush *n* at the same time the nub of the carrier 2^1 touches the brush n^1 and the positive electricity of 2 neutralizes the negative electricity of 2^1 leaving 2 negative and 2^1 positive. At the same time the positive sector *g* repels to the comb *m* positive electricity from the plate *c*, and the negative

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sector g' repels to the comb m^1 negative electricity from the plate c; so that when the carrier 2 leaves the brush n and when it arrives at sector g^1, the carrier and plate about it is strongly negative, and when the carrier 2^1 leaves the brush n^1 and when it arrives at the sector g it is strongly positive. The negative carrier 2 touching the brush j^1 further charges the negative sector g^1, and the positive carrier 2^1 touching the brush j further

Suppose it is in the position shown and started in a direction opposite to that of the arrow. The carrier 3^1, by contact with the brush j^1, is charged with part of the negative electricity of the sector g^1 and carries it away. In the same way the carrier 3 carries away a portion of the positive electricity of the sector g. When these carriers touch the brushes n and n^1, their opposite electricities neutralize each other so far as the induction of the

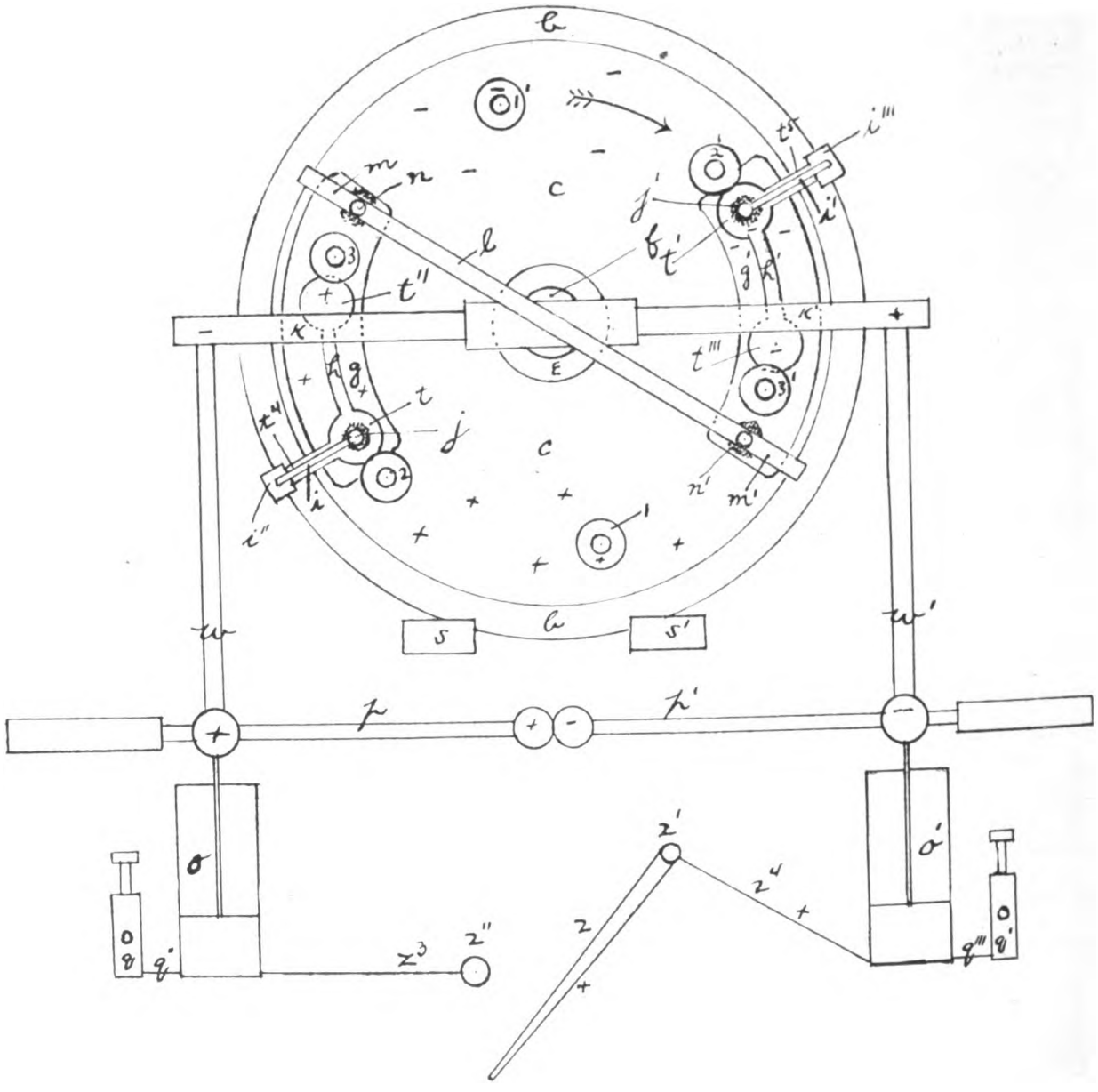

FIG. 2.

charges the positive sector g. This is how the machine "picks up."

The revolution continuing, the outer surface of 2^1 is rendered positive by the induction of the sector g' and this positive surface of the sector and the positive plate surrounding it, repels the positive electricity of the plate and carrier to the comb K and from thence to the inner coating of the Leyden jar o. Similar changes—with the signs reversed—take place on the other side of the machine, still further charging the jar o^1. When sufficient electrical pressure has accumulated, the spark will leap across between the points of the discharging rods.

The cross bar works best when the brushes, n and n^1 touch the nubs of the carriers just as they leave the sectors, as the induction of the sectors assists them in conveying away the electricity.

If the direction of the rotation is reversed, the machine does not act properly, *i. e.* the machine does not "pick up."

positive sector g does not by induction prevent the neutralization of the negative carrier 3, and the — sector g^1 may similarly prevent the neutralization of the + carrier $3'$ to some extent. If these carriers leave these brushes with any charge at all, 3 will be negative and $3'$ positive and the revolution continues. The negative carrier 3 interferes with the normal flow of electricity from the comb K, and so far as any does flow from the comb, the sector 3^1 is rendered the more strongly — and, on touching the brush j, neutralizes to some extent, at least the + sector g and being charged by it positively still further robs it. In the same way the + carrier $3'$ neutralizes and robs the — sector g^1.

If after once starting the machine in the right direction, thus building it up, the rod e be removed, the machine will operate very well, because although the carriers, on touching the brush j, are positive, such positive charge is sufficiently neutralized by being repelled to the comb K, by the positive sector g, and on leaving

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the sector g, the negative charge in lucol by the sector g covers the whole carrier, and before the carrier reaches the brush j^1, its negative electricity being repelled to the nub by the induction of the negative sector g^1, the carrier, on touching the brush, either does not rob the sector at all, or at least not enough to materially interfere with the working of the machine. The probability is that sector g would render the carriers passing the comb K negative by repelling their positive electricity to the comb K, and they would be assisted by the induction of their positive electricity by the negative sector g^1, increasing the negative charge of g^1 by contact with the brush j^1.

Were all brushes removed after the machine was sufficiently

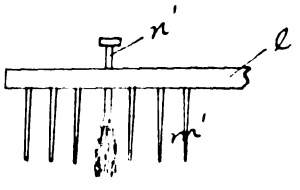

FIG. 4.

FIG. 3.

charged, the front plate would act just as the back plate does in the normal condition of the machine, except that the carriers would, by the induction of their respective sectors, be while passing under the combs, rendered more strongly positive or negative than the glass plate surrounding them. A positive sector would render the surface of the carrier toward the comb more strongly positive, and hence its induction on the comb would be greater, and at the same time the sector itself, at least those portions not covered by the carrier, would also be inducing a negative flow from the comb. At the same time when the carrier leaves the sector, the electricity attracted by the sector would be free to and would neutralize part of the electricity delivered to the sector by the comb, and upon passing over the next sector, another charge of the opposite kind would be induced in the carrier, but no material gain would be made by the whole operation.

To start the machine it is only necessary that the sectors be relatively positive and negative to each other. If the rod m be so placed that the brush n will stand near to, or just over the upper edge of the sector g^1, it will touch the nubs of the carriers, when the direction of the rotation is reversed before the carriers leave the influence of the negative sector g^1; hence it will take from the carriers a repelled negative charge, leaving them positive, and in practice it is found that this positive charge is not altogether repelled by the positive sector g, and hence a very slight positive charge may be imparted to the sector g through the brush j, and the machine "picks up" but very feebly.

When the switch z is closed, it is equivalent to grounding the outside coatings of both Leyden jars, as the repelled charges neutralize each other, and a heavy charge can be obtained on both inside coatings.

The Holtz machine generates a very high electrical pressure, but the current which flows is almost infinitesimal, so that the electrical energy to be derived from such a machine is very small. This class of machines is chiefly valuable for the very high pressure which may be derived from them.

W. P. THORNTON.

A society (?) note taken from the London Electrical Engineer:

ELECTRO-HARMONIC SOCIETY.

Electro-musicians are reminded that it is ladies' night on Saturday, November 30, at the St. James' Hall restaurant, (Banquet Room) Regent street W., at 8 o'clock."

At a cycle show recently in Islington, England, two horseless vehicles were exhibited. One was the Daimler carriage, a full sized phaeton driven by a petroleum motor. The other was an electrically propelled tricycle.

The Carborundum Company of Niagara, operated by electric power has reached a daily output of 4,000 pounds.

RECORDS THE MOVEMENT OF CARS.

The Chronograph Automatically Indicates the Regularity or Otherwise of the Service.

The running of a street car from the time it leaves the terminal shed to its return is generally supposed to be dependent entirely on the motorman and conductor. Few people know that the movement of the car all the time is known to the superintendent in the central office, says the Terre Haute Gazette. He simply consults a chronograph and immediately learns whether the cars are running regularly or irregularly; whether there is a stoppage at any point: how long it lasts: how many cars are blocked, and when the trouble is removed and the road begins operation again. This chronograph constitutes a sort of living map of the road, by means of which the superintendent can take a bird's-eye view of the whole operation of the line. If there is irregularity in the running time without good cause he can check it, and if necessary, trace the exact car which is responsible for the deviation from schedule time. The manner in which all this information is obtained is extremely simple. The chronograph consists primarily of a sheet of paper moving at a uniform rate under a series of pens or points operated by magnets. Each magnet point represents a point on the road, and each time a car passes this point on the road it makes contact and the magnet point on the chronograph makes a mark on the paper. On the frame of the instrument is mounted a back roller to hold a supply of paper, the front roller on which to roll up the record, the top plate holding the magnet points, and the roller, which gives the time of movement to the sheet. This top roller is a series of grooved wheels, one for each magnet point. The importance of this part of the device is obvious, since the movement of the sheet must be absolute and exact or there will be inaccuracy in the time record. The roller is actuated at the rate of one revolution an hour by a powerful clock movement This gives the paper four inches of movement in the hour, or one inch for every fifteen minutes. A line running a one-minute schedule will therefore show fifteen cars or prick marks to the inch, a five-minute schedule three to the inch and so on. A break of two inches would denote a stoppage of thirty minutes at that point. When the superintendent sees a regular, unbroken showing of points on the record he knows that the cars are all doing their full work. The record sheets are dated and filed for reference, and in offices where the chronograph has been used since its introduction, two years ago, the company can instantly tell how the cars worked on any day in that time.

GLUCINIUM.

The American Manufacturer contains a brief mention of a new metal, glucinium, which seems destined to become of great importance in the near future. On account of its peculiar qualities it will be used especially for electrical purposes. As its atomic weight is 9.1 and its specific gravity 2.00, its attractive power is considerably greater than that of iron and its conductivity is equal to that of silver. Glucinium, therefore, is more capable of resistance than iron and a better conductor than copper; and, in addition to all this, it is lighter than aluminum. If the claims of this new metal are confirmed by practical use, there is no doubt that glucinium will be used extensively for electrical purposes, the more so as its commercial value will amount to about $20 a pound, or 160 times less than the same volume and ten times less than the same weight of platinum.

MOTOCYCLE LEAGUE IN ENGLAND.

A meeting of those interested in self-propelled vehicles was announced by recent mail advices to be held December 10, in London, at which Sir David Salomons, Bart., was to preside. A series of resolutions was to be submitted with a view to starting an association to foster what is regarded as likely to lead to important trade interests.

A series of three lectures by W. Worby Beaumont on the subject of "Mechanical Road Carriages" has also been arranged for, to be given at the Society of Arts, John Street, Adelphi.

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CONTEMPORANEOUS COMMENT.

YERKES ON STREET-CAR FRANCHISES.

Mr. Yerkes does not believe in municipal ownership and operation of street railways. He says it is socialistic, and declares that no worse blow could be struck at our liberty than to place under municipal control the transportation companies of the country.

There is at least one thing that is worse than municipal control of street railways, and that is the domination over the city government of these private corporations in quest of special privileges from the public.

To begin with, the city has absolute control of the streets. When these streets are needed for transit purposes it is purely a business proposition as to whether the franchise shall be given over to private parties or whether the city shall own the trackage and lease the line to an operating company, or whether it shall choose to own and operate the road itself. For Mr. Yerkes or any other man to attempt to prejudice the people and prevent candid consideration of the whole subject by dubbing as socialistic and opposed to the principles of government all plans except that one which turns public streets over to private control, like private property, is reprehensible to say the least.

But Mr. Yerkes does not stop with calling other plans than his socialistic. He also presents arguments. * * *

Mr. Yerkes' weightiest objections to municipal control are temporary in their nature and will tend to disappear with time. For instance, he points out that constant service and training for managers and employes are requisites for successful business management. With the introduction of the civil-service system and a little more experience in such affairs that objection will disappear entirely. Assurance of steady employment will attract to the public service a more intelligent class of men and will develop more efficient service than most private companies now afford.

Mr. Yerkes says private management is more economical, by which he probably means that private managers have a better eye to the payment of dividends. Grant, for the sake of the argument, that public management is wasteful. It can be wasteful to a considerable extent and still give more to the public than private corporations that give meager service in order to pay enormous dividends. This fact must constantly be borne in mind. The street railway business is in its nature a monopoly. In competitive business, like the selling of groceries, private managers give good service in order to make money. But it is notorious that managers in control of a monopoly are often insolent to the last degree and give poor service, in order, thereby, to make excessive profits. The people must be so vigilant in order to secure efficient service from a street railway company that in many cases they would better run the business themselves.

Mr. Yerkes says the corrupting and baneful influence of politics would prove disastrous under a system of municipal control. This danger would grow steadily less as the merit system in public service became operative. On the other hand, however, something must be done, and that soon, to curb the corrupting influence in government and politics of private corporations that have or desire public franchises. In the city of Denver, not long ago, the council was deliberately made corrupt in order that a private water company might secure valuable concessions against the will of the people. Who could think of Chicago's water department, under municipal control, exerting such a corrupting influence in politics?

Speaking of efficiency of management, one of the very best cable lines in the world is that over the great Brooklyn bridge. This is an example of most successful public management and the only instance of municipal control of a railway line in the United States so far as we know. The fare is three cents. Despite the large business, there has not been a fatal accident since the road was started in 1883.

But whatever the objections to municipal operation there can be but few to municipal ownership of the tracks. The question of municipal operation is hardly a practical one in Chicago today, though it may be in the near future. But there is no good reason why the city council, with every franchise hereafter granted, should not have an eye to the ultimate reversion of plant and trackage to the city.—*Chicago Record.*

CARS RUNNING WILD AGAIN.

Chief Inspector Franklin has reported that the running time on some of the trolley roads has been reduced, whereby the speed of the cars has been increased, and the net result is an average of two accidents a day. In one case he reports that a car was going at the rate of 24.02 miles an hour on Nostrand Avenue.

These facts show that the policy outlined by the former presidents of certain lines in the observation—"The people want rapid transit, and wee'r going to give it to 'em"—has not been abandoned by their successors, and that the local administration is still simply the tool of the trolley companies. While the Mayor is engaged in a controversy with the Aldermen over the kind of fender that the companies should be forced to use, the railroad managers are increasing the speed in which the real danger of life and limb lies, and getting back to the conditions under which one person was killed and four or five more or less injured every day.

The talk about rapid transit is delusive; what the people want is safe transit, and to have that, they know that rapid transit on the streets is impossible. Generally, the accidents that have occured have endangered only the life of the individual in the way of the car; but, of course, there is equal danger to the persons inside the car; for it only needs collision at a high speed with another car or with some other ponderous vehicle in the way to cause just such a wreck as is now and then caused in the same way on the steam roads of the country.

But it is not necessary to argue this; everybody understands it; and it was because of the common understanding of the whole matter that the popular uprisings of last spring and summer took place, and the Aldermen were compelled to adopt an ordinance to regulate the speed. Under it the inspectors, of which Franklin is chief, were appointed, and the report of the latter, showing only what is apparent to every observer, makes it clear that the law is being violated systematically, and with the knowledge and consent of the authorities.

Such a state of things is bad for Brooklyn; it prevents residents of other places from settling in it, and it drives residents of it to settle in other places, because of the danger to life, especially of the very young and the very old on the public streets; and in this way it is a serious injury to the property of citizens and to the business interests of the city.—*Brooklyn Citizen.*

STORAGE BATTERY FOR STREET CARS.

New-Yorkers will observe with special solicitude the experiments which are being made with storage batteries on the Fourth Avenue surface cars. Similar experiments extending over a considerable period were made several years ago, but the weight of the batteries was so great that the system could not be operated economically. The new system is declared to be a great improvement on the old one, and it is hoped that it will enable the Fourth Avenue line to compete with the cable roads on both sides of it. If it can be made to work successfully, the storage battery mode of electric propulsion will present all the advantages of the trolley system, with none of the drawbacks in the way of wires, conduits and the like.—*New York Tribune.*

At McGill University, Montreal, the deans of the different faculties were all able to report an increase in the number of students for the ensuing year, with the exception of Dr. McEachren who is at the head of the department of veterinary science. In that department it was explained that the displacement of horses by electricity for street car purposes had greatly reduced the business of veterinary surgeons, and hence the falling off in students.

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NEW CHEMICAL BATTERY.

The Gordon-Burnham Company's New High Efficiency Cell In Use in the West.

Mr. Ralph W. Gordon, of the Gordon-Burnham Battery Company, has just returned to New York, after an extended visit through the West. Mr. Gordon brought with him the new Gordon-Burnham battery, which had already created much interest in well-informed circles, because of new mechanical arrangements designed to increase the efficiency of the battery.

As a result of his trip, and the tests that have been made with the battery, a number of railroads have adopted it exclusively, among the number being the Illinois Central, Pennsylvania Lines, from New York to Chicago, the Chicago & Northwestern, the Chicago, Burlington & Quincy, and the Northern Pacific.

The Gordon-Burnham people claim for their battery that its efficiency is four times greater—weight for weight—than the ordinary gravity cell, and tests now going on in the Rice Street repair shops of the City of Chicago, promise to bear out this contention, as the batteries now on trial there have shown up in a surprising manner. The completed data of the tests are not

yet ready, but will be given later. The explanation of the high efficiency of the battery is that its elements are in such shape that a larger surface is exposed than in any other battery, and in consequence, the electrolytic action is greater. One of the great advantages of the battery, is that the solution used is a saturated alkali that will not freeze in any temperature usual in this country. All who use chemical cells know what this means in the way of convenience and adaptability.

The cell is a handsome one in two sizes, of construction as shown in the cut, capable of being assembled and recharged with ease and quickly, is clean, does not leak under any conditions and does not require an expert to either prepare or handle it. The Gordon-Burnham company is to be congratulated on its handsome new achievement.

MUNICIPAL CONTROL.

The agitation for municipal ownership of electric lighting plants is not confined to any city or any section. Commenting on the statement that the agitation in Trenton, N. J., has prospects of success in the near future, the City and State, a Philadelphia reform paper, says, where there is agitation of this subject of course the successful ending cannot be far off:

"The reasons are all of one sterling staple, and all tend in one way on this question of municipalizing public service in towns and other centers of population. Wherever it has been tried, never is there a going back on it—not a single instance. Every kind of such service, not only street lighting and water service, but street car communication, telephone and telegraph and parcels post service, all things of that sort—just as surely as the carrying of letters or mail matter for the people of the country at large, should be done by public instrumentality for the public convenience and advantage. Any line or department of service for which there is a large popular demand, ever increasing, looking toward indefinite extension, a well-nigh universal demand, in fact, should be municipalized, not monopolized. The continued monopolization of it is a crime against society, and, particularly, it is always a grievous wrong done to the poor."

This idea is really the tie which holds together the new municipal reform party of Boston, which is running Prof. Frank Parsons of the Boston University as its candidate for mayor. We do not expect that he will get a great vote this year, but he is certainly enlightening the people. Boston alone, he says, would save a million and a half a year if it owned its gas and electric lighting plants. There are now 200 cities and towns in the United States which do their own electric lighting.

CAUSE FOR THANKFULNESS.

American electrical engineers may be glad that in addition to their numerous troubles they do not have to tussle with such names as the following: Gödöllö, Puszta-Szent-Mihaly, Csömör, Kerepes, Kis-Szent-Miklos, Pest-Pilis-Solt-K. Kun, Vácz-Hartyán, Kolozsvár, Nagyvarad-Kolozsvár-Brassö, Kolozsmonoster, Szász-Fenes, Szasz-Löna, Gyalubis, Hideg-Szamos, Miskoloz, Rákos-Palota, Uj-Pester, Keschitza, Krassó-Szörény—all of which are places in Europe where electric light and power stations have recently been installed. It is interesting to notice that no mention of the telephone is made in the paper from which we have taken these names, and one cannot help wondering whether it could be used in that country, and, if so, how long it would last.—*The Electrical World.*

The United States Treasury is run for the benefit of England. It is the one spot, and the only one spot on earth, except in mines, where the London bankers can always get gold. They have only to present Treasury notes or greenbacks to get it, though both of these forms of paper are redeemable in silver as well as gold. France has paper money redeemable in either metal coin, but when the London bankers try to rob the Bank of France of its gold, by presenting its paper for redemption, they get silver. Still, gold don't go to a premium on that account, as the goldbugs here say it would if our government redeemed its obligations in strict accordance with the law. What liars our goldbug friends are, and "what fools these mortals be!"—*Mining Industry and Review.*

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

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THE SCIENCE OF PHOTOMETRY.*

Procedure for Determining the Candle Power and Efficiency of Incandescent Lamps and the Apparatus Necessary to Make the Required Tests.

THE ARRANGEMENT OF A PHOTOMETER ROOM.

The arrangement of a photometer room, and the apparatus to be used in it, depends upon the class of work to be done. If it is desired to make accurate measurements of the candle power and efficiency of incandescent lamps, the following apparatus is desirable: A Dibdin Pentane Argand Standard burner, or a Harcourt Pentane Lamp ,No. 2, as a standard of light. An accurately graduated photometer bar, about two and one-half meters long. A Lumnur-Brodlum sighting box, or a sighting box containing a Leeson star disc, or a Bunsen disc, the choice being in the order given. An incandescent lamp holder of suitable form. An ammeter and a voltmeter, with other apparatus necessary for testing their accuracy from time to time. A storage battery and rheostats for adjusting the potential at the lamps terminals. As the sperm candle is the only standard of light which is recognized by law, such candles should be provided, with a balance for determining their rate of burning.

The photometer room should be large and free from vibration. All flame standards are quite sensitive to air currents and should therefore be thoroughly protected from them. The standard should be placed in a box-like inclosure at one end of the bar. The box should be 20 inches to 30 inches square and should be three feet high. It should have an opening of about 100 square inches at the bottom for the admission of fresh air, and a similar opening at the top to allow heated and foul air to escape. If necessary, these openings must be specially screened, but not obstructed, to exclude air currents. The front of the box should be provided with a door, in which, at the level of the standard flame within, a piece of blue glass should be inserted to allow one to adjust the flame without tiring the eye and interrupting the photometric readings. A similar box should be placed at the other end of the photometer bar. Each box must have an opening next the bar, at the level of the sighting box. The opening should be only large enough to allow light to pass from every part of the inner light source to every part of the disc in the sighting box. It is well to make the hole in the box rather large and to provide a number of pieces of blackened cardboard, having apertures of different sizes and forms, so that the one of the right size may be readily placed on the hole in the box. The interiors of the two boxes should be thoroughly painted with a lustreless black paint, to avoid reflection of light toward the photometer disc.

As the purpose of the measurement is to compare the intensities of the radiations coming from the two light sources themselves, great care must be taken to entirely cut off all other light. The space about the photometer bar, between the two boxes, must be completely inclosed, either by boarding painted black, or by black cloths. The front should be provided with heavy black curtains, leaving room within for the one who reads the disc. In addition to this, it is necessary to provide screens so placed as to cut off light reflected or diffused by the black surfaces, for it is seemingly impossible to find a paint or a fabric which will not reflect some light. The screens may be conveniently made of pieces of blackened cardboard having proper apertures at the level of the disc. The screens may be tacked to blocks of wood, and placed on the bar. The screening may be done by pieces of black cloth, hung from the cover over the bar, but cardboards are more convenient, as they may be readily shifted along the bar. The screening should be so perfect that the disc is invisible when the apertures in the nearest screens are covered, all others being open and the lights burning.

The person who reads the disc should keep his eyes in total darkness for a minute or more before beginning to read, and should avoid looking at the lights, or exposing his eyes to any light, if he can possibly do so. A glance at an incandescent light will unfit him for good work for some minutes.

It will, of course, be necessary for him to see the scale on the photometer bar, to take his readings after setting the disc This may be conveniently provided for by placing a small incandescent lamp on the sighting box, near the index and lighting it by pressing a key when reading. The lamp should be screwed on the side toward the observer. A "pea lamp" may be used, placing a suitable resistance in series with it.

As the candle power of an incandescent lamp increases rapidly with increased voltage, it is necessary that the latter be capable of very accurate adjustment. This may be accomplished by placing a rheostat and a "slide wire" resistance in series with the battery and lamp under test. The rheostat enables one to make the rough adjustment, and the slide wire to make the final adjustment. Instead of the slide wire, the terminals of a second rheostat may be attached as a shunt to the last two or three sections of the first rheostat, thus serving the same purpose. The voltmeter should be read with a magnifying glass. It is desirable to have two observers, one to read the disc, the other to adjust the circuit, watch the standard and write in the note book the various readings taken.

For measurements on gas lights, an experimental meter for measuring the flow of gas, is necessary, together with the necessary valves, pressure gauges, governor, thermometers, barometer, etc.

In lamp factories and electric light works, it is, of course, impossible to take the time and care involved in carrying out the above plan, and a less elaborate arrangement is sufficient. A Lumnur-Brodlum sight box will prove best even in such work, however, giving more accurate readings with no loss of time, and with less fatigue to the observer. An incandescent lamp may be substituted for the standard burner, if it has been previously accurately standardized, as above. Such a lamp is even better than the standard burner, if the lamps under test are to be supplied with current from dynamo mains, as is usually the case. The voltage of such mains is continually varying, and it is therefore impossible to keep the lamp which is under test, at constant voltage while taking the photometer reading. If the standardized lamp is attached to the same leads as the lamp under test, the changing voltage will affect both lamps alike, if they be of the same efficiency. Even if they be of different efficiencies, no serious error will be introduced, if the variation in voltage does not exceed a volt. The accuracy of the ammeter and voltmeter should be as carefully tested and as closely watched, as in the more refined work.

Brig. F. Thomas.

* Continued from November 1

LACKING IN QUANTITY PROBABLY.

Electricity is a powerful force. There is no doubt of this. It can destroy life in a second's time, and it has also been successfully used to restore life. It makes a thousand miles but as a cubit's length, and has brought us into speaking acquaintance with the farthest ends of the earth. It makes night as day and has in many places usurped the sun's place. It moves the printing press and the loom, and its force is felt throughout the world. Every one recognizes its almost infinite power and admires the minds which have curbed it for the use of man.

But there are some things which electricity cannot do. In spite of its almost omnipotent force; in spite of the fact that it can girdle the world in a moment and give and destroy life; in spite of the fact that it rivals the sun in brilliancy and pulsates through the entire world, it cannot, through the agency of five small radiators, shut up in boxes under the seat, heat a thirty-six foot street car with the mercury down to zero. This statement is made just as a pointer to Mr. John Scullin and the management of the Union Depot Street Railway Company.—*St. Louis Star Sayings.*

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THE AMERICAN MOTOR LEAGUE.

Organization Completed—The New Association Goes Directly Into the Work of the Advancement of the Motor Vehicle—Conditions of Membership.

WHAT IT AIMS AND EXPECTS TO ACCOMPLISH.

The first work of the newly-elected Executive Committee of *The American Motor League* was the selection of Mr. Charles E. Duryea, of Peoria, Ill., for President of the League. The first annual meeting of members thought it wise to select for the first president some man of national reputation and an avowed friend to the Motor Vehicle. The names of Mr. H. H. Kohlsaat and General Miles were mentioned, but the matter was finally left to the Executive Committee. That committee, after canvassing the matter thoroughly among themselves, decided that the first president must be very active in the work of organization, and it could not be hoped that either of the gentlemen named would be able to give much time to the work, hence Mr. Duryea's selection which seemed to be especially timely as that gentleman was brought into great prominence by the awarding of the first prize in the Times-Herald contest to his vehicle.

The Executive Committee of the League consists of President Duryea; Vice Presidents Henry G. Morris, of Philadelphia; H. D. Emerson, of Cincinnati, and Hiram P. Maxim, of Hartford, Conn.; Treasurer, Charles B. King, of Detroit, and Secretary, J. Allan Hornsby, of Chicago. The board has established permanent headquarters, with Secretary Hornsby in charge, at 335 Dearborn street, Chicago, through whom all business of the League will be transacted, including applications for membership.

Under the constitution the fees for membership are two dollars as an initiation fee and one dollar annual dues, both payable on application for membership.

The purposes of the League are set forth in the Constitution Art. I, Sec. 2, as follows:

"The purposes of this association shall be the advancement of the interests and the use of motor vehicles. This shall be done by reports and discussions of the mechanical features, by education and agitation, by directing and correcting legislation, by mutual defense of the rights of said vehicles when threatened by adverse judicial decisions, by assisting in the work of constructing better roads, better sanitary and humane conditions, and in any other proper way which will assist to hasten the use and add to the value of motor vehicles as a means of transit."

Concerning membership the constitution provides that: "Any man or woman eighteen years of age or over, of good moral character and respectable standing, friendly to the motor vehicle and its interests, shall be eligible to membership and may become a member by application to the Secretary of the League."

The first substantial work done by the Executive Committee, after the election of president and the instruction of the secretary as to literature, was in the direction of securing the removal of any prohibition on the part of Chicago park and boulevard commissioners against the use of motor vehicles in the Chicago parks and along the boulevards. Those who know of the arrest and detention of the drivers of several of the contestants in Chicago recently will appreciate the necessity for action in this direction. Already the action taken by the board has borne fruit, the police captain of the West Park system having been instructed by President Harvey T. Weeks to admit motor vehicles on an equality with other vehicles. Similar action has been since taken by the Lincoln Park Commissioners.

Before he shall be needed, the executive committee will appoint an attorney to look after its legislation and litigation. In the meantime the board has resolved itself into a sub-committee specially for the purpose of drawing up conditions upon which motor vehicles will be entitled to the protection of the League. These conditions will take into consideration those features that have made this class of vehicles objectionable in the past—noise, smoke, steam, unsightliness, etc.

The board has divided among its members the territory of the United States and Canada for purposes of organization, the allotment being as follows:

Mr. Maxim, New England; Mr. Morris, New York and Pennsylvania; Mr. Emerson, Ohio, Indiana, and everything South; Mr. King, Michigan and Canada; President Duryea, Illinois and everything West and North.

A committee has been also appointed to secure the participation of the League, in an advisory capacity, in all motor vehicle contests to be inaugurated in the near future.

The League began its existence with sixty members. The number has doubled in the first week of its career, and there is hardly a doubt that its membership will extend into the thousands by the time the annual meeting takes place in June next.

OFFICERS OF THE LEAGUE.

CHARLES E. DURYEA,
President.

HENRY G. MORRIS,
Vice President.

J. ALLAN HORNSBY,
Secretary.

CHARLES B. KING,
Treasurer.

NATIONAL GOOD ROADS.

Colonel Albert A. Pope, who has done such grand work for the national good roads cause, writes:

"It would be a good thing if the Government would extend the good road work in the Department of Agriculture and build the great national highways. Then, if the States would follow the example of New Jersey and Massachusetts and build State roads, leaving to towns and cities the streets, we would, in the course of time, develop a system of highways not excelled by any in the world. It has got to come. Perhaps we may not see it, though I hope to. Horses have seen their best days. Electricity and bicycles have partially done away with their use, and before this century expires practical motor carriages will be in use. Then the demand will be for still better roads and good roads in all directions, and the poor old horse will be relegated to the country, where he belongs."—*Urbana Democrat.*

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

VOL I. CHICAGO, DECEMBER 15, 1895. NO. 14.

The Trolley Question.

Since our last issue discussion anent the overhead trolley has waxed warm and interesting. Among the most important contributions is that of Mr. B. E. Sunny, Western manager of the General Electric Company, in an interview in a Chicago daily. The gist of Mr. Sunny's opinion is that the *unsightliness* of the overhead trolley is its only disadvantage.

We do Mr. Sunny's intellect and judgment the honor to say that he knows better than this: if he did not know better he would not hold his present position. Then why does Mr. Sunny take such a position? Because it is the policy of his company? Why is it policy? The dictators of the policy of the General Electric Company are usually credited with at least ordinary business wisdom, and there are some things about the overhead trolley that they must know perfectly well, and if they know them, they also know that these things are obstacles in the way of the development of electric traction. These are a few reasons why the overhead trolley is not satisfactory:

1st. It is against the same expressed public sentiment that drove the telephone, telegraph and electric light wires into conduits.

2nd.—There are suits on now against overhead trolley companies brought by water and gas companies, demanding damage for the electrolytic destruction of gas and water pipes; moreover there is enough to these suits to engender an uneasy feeling on the part of all companies using overhead lines.

3rd.—The Fire Underwriters have openly avowed their intention to raise rates on property adjacent to overhead trolley streets. This will affect property owners, and street railway companies know what nightmares protesting property owners can conjure up.

4th.—The claim of cheapness of the overhead trolley as against conduit wires is not confessed, and will not be admitted until demonstrated, and this demonstration seems to be forbidden for some reason, by those whose best interests would be served thereby.

5th.—The overhead trolley, in the air, over a street where there are pretentious and handsome architecture, is criminal in its unsightliness.

It is the business of the electrical manufacturing companies to study out and advocate anything that will promise a quicker commercial development in any electrical direction and it is equally to the interest of the electrical periodicals to do the same thing, so that there is identity of interest: the only question is that of judgment.

THE ELECTRICAL JOURNAL believes that a prompt demonstration of the satisfactory operation of the conduit for electric traction, would mean its immediate adoption on every steam road having a suburban service. In our last issue, we printed an interview with Chief Engineer Wallace, of the Illinois Central road, entirely bearing out the above views. Epitomized, Mr. Wallace's views are these: Electricity is better than steam, on all points including economy, for moving small units (meaning light passenger trains) over short distances (such as suburban service), with frequent stops. Mr. Wallace ends his interview with the statement that he does not believe the overhead trolley is the ultimation on the subject, and yet he is quite sure that the conduit trolley has not been demonstrated a success—therefore he will offer nothing to the management of his road until he has a successful system other than the overhead trolley.

It seems to us that the "riot act" could not be put in much stronger language than this, and coming from the source it does, it ought to be a sufficient hint to the wise.

* * *.

Electrical Inspection.

The National Board of Fire Underwriters, which met in New York on Dec. 11th, and later, has power to crystallize some most necessary action looking to better construction, both in work and material. That the Board fully appreciates its position in the matter is proven by the avidity with which it keeps up to the times. But the National Board is not all powerful, and it is vastly to the interest not only of the fire insurance people, and builders, but of electrical manufacturers as well, that there should be some definite, national and systematic move made looking to the testing, and approval or rejection, of every sort of material used in electrical installation.

Many manufacturers are now finding that much of the material they have on the market is accepted by some inspection bureaus, and rejected by others; and users are often compelled to take out material and substitute something else, after one or more inspection departments had approved it. In some cases, this "lash tag" play among inspectors would be extremely ludicrous if it were not so costly both in time and money. For instance in New York City there are two or more fire insurance boards, each independent of the other, and at least one city inspector. One of these departments passes a piece of work and the material in it, and the job is completed in the best of faith on the part of the contractor. Then along comes another inspector with that *peculiar modesty* which usually characterizes that grade of man when clothed in a little brief authority, and orders the work stopped and a lot of material taken out. The explanation that some other bureau has passed the work never fails of the effort *not* intended, for at once it becomes the inspector's duty to uphold the dignity and authority of his own particular patron by raising Cain generally in order to discredit the opposition. Of course we fully understand that the last inspector represents the only authorized and responsible institution, but that does not save the time and money necessary to make changes, and even then there is no assurance that the two concerns will agree as to what shall be used, and oftentimes the builder plays the unenviable part of the bone of contention. All this gets to be very funny sometimes to the man up a tree, but it is a very serious thing, where it involves the whole building country, as it now does.

For a cure of this evil, there should be some sort of National board-government if possible, if not then made up of either state or municipal representatives. This board should have a testing and approving department, composed of great big men, whose knowledge and integrity are both above suspicion. Such a working institution as this could be made, if operated under

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proper rules, to save vast amounts of property, great time and much guess work on the part of electrical manufacturers. The institution could send out reports monthly approving and rejecting new material offered, the rules for installation would be alike everywhere, and the whole country could be made to work in harmony. Inspection would then be a matter of form; at any rate there would not be a feeling of uncertainty among manufacturers concerning the acceptance of their goods, and it would not be necessary to keep in touch with an infinite horde of independent inspectors, working under as many sets of rules.

* * *

Three-Cent Railway Fares.

There seems to be a demand in many parts of the country for a three-cent street railway fare. The basis for the demand is doubtless in the fact that street railways are making a good deal of money, more especially since the introduction of the trolley system. Reports have gone out, and there is probably more or less truth in them, that as compared with the old horse car system, operating expenses are materially less and the gross receipts considerably more, and that in consequence passengers can now be carried for three cents instead of five and still leave a legitimate profit.

It is claimed by advocates of the reduction that street railways pay little or nothing for the privileges they receive from cities in which they operate, and for that reason alone, if for no other, the public should be given the lowest possible rate. Almost in the same breath with a demand for reduced fares, come complaints from these same people that the service is not satisfactory. The cars are over-crowded, they say. They are not sufficiently lighted. In winter they are cold and uncomfortable. There are no cars run late at night or early in the morning, presumably because the passengers are few and the service unprofitable; and they have numerous other complaints, many of which are possibly well founded, let us say they are for the sake of argument. What is the remedy? Will a reduction in the fares from five to three cents insure less crowding of cars? Will it be an inducement for railways to operate an all night service for the benefit of the few to the detriment of the financial interests of the company? Will it be likely to improve the service in any respect? It is hardly good judgment to expect that it will. What the public wants and what it has a right to expect is an efficient service in the fullest sense of the term and that there is room for improvement from the standpoint of the traveling public, no disinterested party will deny; but if it is ever to be brought about it will be by other tactics than that of reducing the fares. Beside the bad judgment of demanding reduced rates, may also be placed the fact that very recently, nearly all the electric roads have been at great expense transforming their roads—at the demand of the people—from horse roads to electric. Would it not be reasonable to allow the companies to recoup themselves for the unusual outlays before attempting to reduce their incomes? Even railroad companies are entitled to *some* consideration.

* * *

A Mistaken Policy.

Manager Beggs of the Edison Company, of Cincinnati, is chafing under the collar a good deal because he is compelled to do his business in a business-like manner. The trouble with Mr. Beggs is that he is overburdened with a sense of his own importance and nothing pleases him quite so much as playing the part of an autocrat. If he knew that a certain piece of work had to be done in a prescribed way, nothing would please him more than to do it after some other fashion, and then force it through. Unfortunately for Mr. Beggs, however, he has to deal with a man in the person of City Electrician Cabot, who not only knows his duty, but insists on performing it, much to the chagrin sometimes of those with whom his office brings him in contact. Mr. Beggs had some wires to string, and he strung them. He had lamps to hang and he hung them, and then he applied for a permit to turn on the current. This Mr. Cabot declined to do and gave as his reasons that "50 per cent. of the poles put up were leaning in all directions, because they had not been well tamped; 10 per cent. of the lamps in the district were hung near the poles instead of at the end of the cross-arm, where they belong; then the guy wires were so low, especially in Burnet Woods Park, that they were dangerous to children; the guy wires had no circuit breakers in them to prevent the powerful current from being sent from the wires to the earth, and shocking persons; the wires were without the extra insulation where they pass through the wires of other companies, making it dangerous for telephone wires, and liable to start fires by their burning out: the Edison Company had placed five cross-arms on the poles where only four are allowed, making it dangerous for men trimming the lamps, and finally, Mr. Cabot says, 60 per cent of all the wire in the district is strung very slack and appears unsightly."

When the matter was brought to the attention of the governing Board it was very properly decided that Mr. Cabot should be upheld in his action. The result is that Mr. Beggs has had to do finally what he might just as well have done primarily. He would have saved himself much expense and trouble, and the public much inconvenience. "Experience is a dear school, but fools will learn in no other."

* * *

The Electric Light as a Moral Power.

Dr. Saunders, the health officer of London, claims that electricity is a great moral power, in that it purifies the air, or rather does not vitiate it as gas does. He says, too, that it brings hope and cheerfulness to take the place of dull misery so often found in the crowded and dark quarters of great cities. The Doctor is doubtless right in his views so far as he has investigated the matter but it is greatly to be feared that his judgment has been based entirely upon a one-sided view of the situation. Take for example an occasion like the sudden going out of the lights in Chicago recently. There was an instance when the moral status of thousands of people experienced a slump which obliterated at one fell swoop all the refining and elevating influences probably of months. And thus in that wicked city of New York, where they had a similar experience! As we contemplate the flood of morality and cheerfulness and *other things* that must have welled up out of the darkness in the Tammany town, our blood refuses to course. And then when the trolley stops for want of "juice!"

No Doctor! Electricity is not invariably a great moral agent, unless that we assume that trials and temptations overcome, chasteneth the pure in spirit.

* * *

Science in Poetic Garb.

We tried once to weave a romance into a description of a dynamo. We were not successful, and so are glad to take off our hat to Mr H. N. Abbott, who in Electrical Engineering, gracefully dove-tails the following couplets into a technical paper on "Central Station Economics;"

> "Imperial Cæsar, dead and turned to Clay,
> May stop a hole to keep the wind away."

And again;

> "Full many a flower is born to blush unseen
> And waste its sweetness on the desert air."

We suppose of course that Mr. Abbott means, by the last lines, which we think we have seen before, that there are leaks in the circuit somewhere, and the reference to "clay" in the first stanza, advertises porcelain cut-outs. Who would have thought that Gray had in his mind "Central Station Economics" when he penned his immortal elegy?

* * *

In recent amendments to the British wiring rules is the following section:

> Every electric line shall be tested for insulation after having been placed in position, the testing pressure being at least 200 volts, and the undertakers shall duly record the results of the tests of each line or section of a line.

We do it differently over here. The "undertaker" records the results after the test is completed.

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Vice-President C. L. Bonney, of the Chicago General Railway Company, is still trying to run his road by way of the law courts, and as litigation is a little slack, he fixes up a case on himself by going before the Corporation Counsel to plead guilty of the violation of the city ordinance licensing each street car in the city and imposing an annual tax of $50.00. Now if Mr. Bonney will confess judgment and pay the bill, then put himself under a bond to keep the peace, we shall all be happy.

The Cleveland real estate people who are offering lots for sale in a new subdivision, and hold out as an inducement that a "ten minute service of electric horseless carriages" will be provided, are either bold or bad—perhaps both. They should have said the carriages would be operated by the Keeley Motor. Why strain at a gnat when there is a camel standing by?

The British Colonial office is discussing plans for an ocean cable to be laid in the Pacific, from Canada to Australia by way of a lot of islands, "which it is proposed shall pass entirely through British territory." We know that Johnny Bull is of opinion that he owns the earth, but this is the first intimation we have had that he claims the bottom of the seas.

Now that the greater New York problem has died out and left Brooklyn stranded in the matter of notoriety, the curtain has been rung up on the deadly trolley again. By the way, why keep up expensive plants and special press bureaus to electrocute criminals, when banishment to Brooklyn would serve the purpose equally well, and cost less?

Our friends of the British Electrical press have undertaken to disprove the statements as to the fast time recently *alleged* to have been made on the Nantasket Beach road and the Lake Shore. The disproof they offer is that no *Englishman* saw the fast time made. That settles it! Why pursue the subject?

It is semi-officially stated that there are now more than 200 cities and towns in the United States doing their own lighting. A very short time ago Chicago started the ball rolling. Some *good people* said it was insanity, other *good people* called it crime. Both the diseases seem to be catching.

"Conduits for Electric Cars," is the heading of an article in one of the leading daily papers. That is a good idea. Get the electric cars running in conduits and it will solve a great many knotty problems. Brooklyn would be a good place to try the experiment.

A good many people in the electrical business, act as though they thought the very apotheosis had been reached, and everything in the future of electricity would be a sort of toboggan slide to the demnition bow wows. Well, we predict it won't!

Denver has joined in the cry "overhead wires must go."

LOCOMOTIVE CARRIAGES FOR COMMON ROADS.

This was the title of the paper which was read at the Society of Arts on Wednesday evening by Mr. H. H. Cunynghame. Sir Frederick Bramwell was in the chair, and among those present were Sir David Salomons, Mr. Shaw Lefevre, Mr. Hiram Maxim, Mr. Thornycroft, Prof. Hughes, and Mr. Vernon Boys. Reverting to the consideration of the various sources of power that might be utilized for mechanical carriages, the lecturer said that while electricity had been successfully applied to tramways, its use for ordinary road locomotion presented greater difficulties. Accumulators were very heavy, and in the case of road cars that was a serious consideration. To supply 1½ horse-power or 2 horse-power for ten hours they would weigh about 1¼ tons, and a carriage with that load would have practically no carrying capacity. However, both in this and in other countries, electrical wagons and road carriages had been constructed. Referring to the carriages that competed in the Paris-Bordeaux race, Mr. Cunynghame felt bound to say that as regards design there was much room for improvement. He was surprised to see the cog-wheels made with cast teeth instead of the proper epicyclic teeth cut from the solid, as found in good machinery. One of the best known carriages at present was that of the Comte de Dion, which was a pretty little machine moved either by the feet or by an electro-petroleum motor, or both. To Mr. Shaw Lefevre, he said, was due the credit of having taken up the question in the last Parliament, and there could be little doubt that if Parliament saw its way to remove the present restrictions the foundations would be laid of a great and lucrative industry. In the discussion which followed, Sir F. Bramwell, Mr. Shaw Lefevre, Sir David Salomons, Mr. H. Maxim, and the Comte de Dion took part. The discussion was ultimately adjourned.—*London Electrical Engineer.*

YERKES MEETS HIS MATCH.

Mr. Barrett's reply to the strictures of Mr. Yerkes upon the municipal electric light plant ended with the intimation that Mr. Yerkes is not sufficiently careful as to his facts and that if he is really anxious to get the right view of the question he should apply to the department of which Mr. Barrett is the competent, and, on occasion, combative chief.

Mr. Yerkes' assertions are challenged, his conclusions refuted, his pretensions put to scorn by the veteran electrician, who adds to the confusion of his opponent's overthrow by a suggestion that Mr. Yerkes' interests in the matter are flatly opposed to those of the public.

Mr. Yerkes had stated that there is no city in the world which pays so much for public lighting and so little for private as Chicago. To this Mr. Barrett replies that Chicago is getting her street lights at actual cost, while in many cities where corporations are furnishing these at a low cost, the difference is charged up to the private consumer, who pays more for his private lighting than is paid here. The cost per street electric lamp in Chicago last year was $96.67. Assuming that is, say, a hundred dollars during 1895, the figure is still far below that of New York, where the least expensive lamp costs $146; of Brooklyn, where it costs $127.75; of Boston, where it costs $124.10, and of Philadelphia, where the average rate per lamp is $151.

Mr. Barrett points out that the critics of the present Chicago plant, in getting at their estimate of the cost per lamp, add for interest, depreciation, water taxes and insurance. The effect of this is, of course, to mislead the public.

The city electrician knows what he is talking about, and we may accept his assurances that the cost per arc lamp here is less than in four of the chief cities of the country, while the candle power is in excess of that supplied in several.

Would Mr. Yerkes put the price to the public below actual cost and make up the deficiency by raising the rates to the private consumer? Or is he getting ready to bid for the electric lighting of the city from a gigantic plant of his own?—*Chicago Evening Post.*

THE KEELEY MOTOR.

The following tribute is paid to the Keeley Motor by an exchange: "The Keeley motor continues to assert itself. It is undownable. It subsides for a time and reappears as an iridescence on a disc. It has its veiled mysteries, and these in an avowed invention, as in a secret order, have their special fascination. It is certain that both faith and curiosity have not yet become dead moons on the horizons of certain minds. Nor are these limited to the lowly in purse or brain. Men with an exceptional deposit both of yellow and gray material pay their tribute in handsome quotations to the fetich of a secret yet in its shell. It may be that something surprising has yet to pop up, and that an eagle rather than a wren will peck its passage through the egg. Till then the practical man will wait for results, and the dreamer still find a panorama in his nightcap."

The testimony before the Senatorial investigating committee, says the Philadelphia Inquirer, has brought out the fact that a half a million dollars a year in round figures is being wasted by Philadelphia in the matter of electric lighting, and that the erection of a municipal plant would mean the saving in 1896 of not less than a million dollars.

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UNDERGROUND TROLLEY SYSTEM.

Cincinnati has Investigated the Subject and Favors a Change from the Overhead Trolley.

Several months ago the Board of Transportation of Cincinnati discussed the necessity of doing away with the overhead trolley in that city and inclined to the conduit system as a substitute, but they lacked definite information to enable them to come to an intelligent conclusion in the matter. They knew that overhead wires were unsightly and dangerous but they were not sure that the conduit system was practical, and wanting to act rationally, they appointed Mr. Fred Pentlarge to investigate and report. Mr. Pentlarge has just submitted his report to the Board. It is as follows :

"In reply to my request, Mr. F. Harschitz, M. E., of Vienna and Buda Pest, reports that he built the Buda Pest underground conduit road in 1892, and that the same has been running ever since then, and at a reduction in cost of running expenses of 50 per cent. when compared with cost of former horse car lines. The system is perfectly safe, not affected by wet weather or snow, has stood severe tests in that line, and is being introduced into other large cities with good results. The Buda Pest road is running through the heart of the town and has many curves and up and down grades, and has been a paying investment to its stockholders. He furnished me with drawings and specifications of said road, and I have the assurance that Mr. Harschitz will come to Cincinnati and will undertake the building of an underground conduit road, if his expenses can be guaranteed. As he is a responsible engineer and contractor, having built thousands of miles of railroads in Austro-Hungary and Germany, he would guarantee a success of any road which he would undertake. The cars on the Buda Pest line are similar to ours, and are manipulated in the same manner as the electric cars now in use, have a positive acting fender, which has worked in every instance and has saved several lives, and the change in our cars would be very light.

The change in road bed would be greater, but would well repay the extra cost, when the expense of maintainance of trolley wires and poles is taken into account. Once the conduit is established it would last forever. To any person sufficiently interested to call at my office in the United States Bung Manufacturing Company I will give any further information and show all the drawings and specifications in my possession. I desire to express the opinion that the lives of our citizens and the security of our fire department in extinguishing fires without hindrance of live wires ought to be sufficient ground for full investigation of this subject by the Board of Administration, and if found correct the railroads ought to be compelled to put down wires as soon as practicable. Respectfully,

FRED. PENTLARGE.

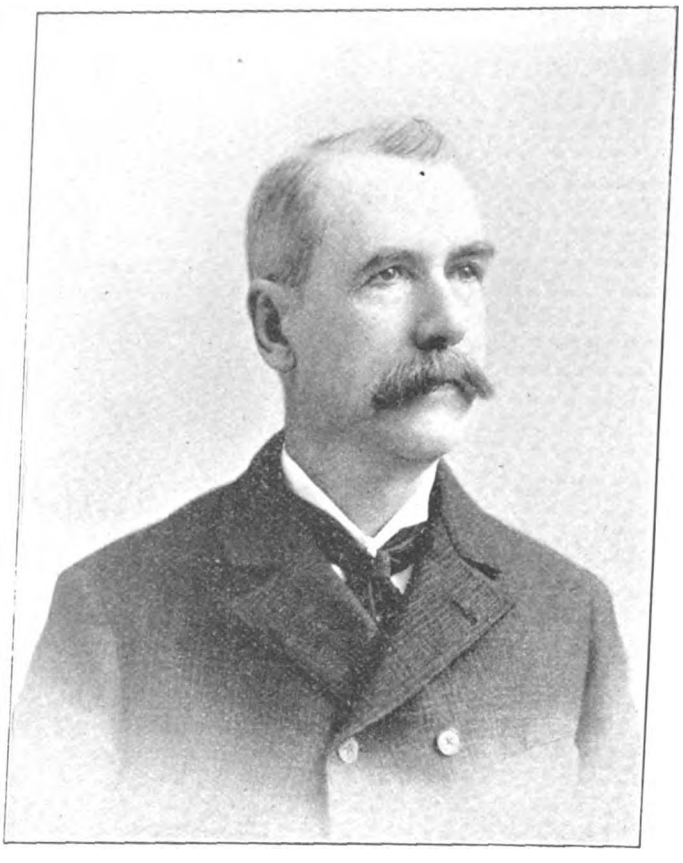
The report was approved and earnestly commended to the consideration of the street railroad companies and the public, and the following resolution was unanimously adopted :

Resolved, That the Secretary be directed to send a copy to the Board of Administration, requesting its special consideration, and that it honor this board with a reply, stating whether, in its judgment, it will be to the public advantage for the board to further continue its investigation.

INCREASE OF CAPITAL.

At the annual meeting of the Board of Directors, of the Phœnix Carbon Company of St. Louis, held on the 10th inst., it was voted to increase the capital stock of the company from $100,000, its present status, to $250,000. This increase will be immediately paid in and will be used for extensions and enlargement of the present plant and to give better facilities for their rapidly developing business.

It may not be out of place to note that the necessity for this increase in capital closely follows the action of the company in bringing their excellent manufactures to the notice of the electrical fraternity through the columns of THE ELECTRICAL JOURNAL. Modesty forbids us to say more.



MR. JOHN YOUNG.

The subject of this sketch, Mr. John Young, is the "guide, philosopher and friend" of the Western Electric Company. Mr. Young has not marched to brass band music since the close of the civil war. He is not heralded when he goes or comes, he wears no frills, furbelows or flounces, but he usually gets to the point for which he starts. He is, in very truth, a hard-headed Scotchman, belongs to the realistic school, takes things as they come—that is if he likes them—or lets them alone if they are not to his taste.

Mr. Young was born in Scotland in 1840, came to Chicago in 1854, has been in the electrical business over twenty-five years and with the Western Electric Company for eighteen years. At the breaking out of the war in April, 1861, Mr. Young enlisted in the 19th Illinois infantry, arose to the captaincy of his company and was severely wounded at the head of his command in the battle of Chickamauga. He shared in all the campaigns of the western army, serving under Fremont, Buell, Rosecrans, Thomas, Grant and Sherman. Soon after being mustered out of the service at the close of the war Mr. Young celebrated his discharge by getting married. He has a wife and two lovely daughters and he doesn't care who knows it. Mr. Young's principle in business is to sell a first class article and get for it a first class price, and in living up to this principle he has done more for electrical interests than almost any other man. He believes that his company can always afford to lose a job, but it cannot afford to do a bad job or to get a poor price. Mr. Young's native modesty has been overcome in allowing the use of this sketch and his photograph by the fact that he finds himself in excellent company.

UNDERGROUND TROLLEY LITIGATION.

Thomson-Houston Company Wins a Suit Against Winchester Avenue Railway.

Judge Townsend, in the United States District Court, has rendered a decision in the case of the Thomson-Houston Electric Company against the Winchester Avenue Street Railway Company by which the claim of the plaintiffs to the Vanderpoel patents is sustained. The suit was in reality an issue between the General Electric Company and the Westinghouse Company and called for a perpetual injunction restraining the use of the underground trolley on the Westinghouse roads. The injunction, it is said, gives to the General Electric Company the exclusive right to manufacture and sell the underground system. The case will be appealed to the United States Supreme Court.

Nashville has commenced work in connection with its centennial exposition which will open next fall. Among the other attractions will be an electrical display.

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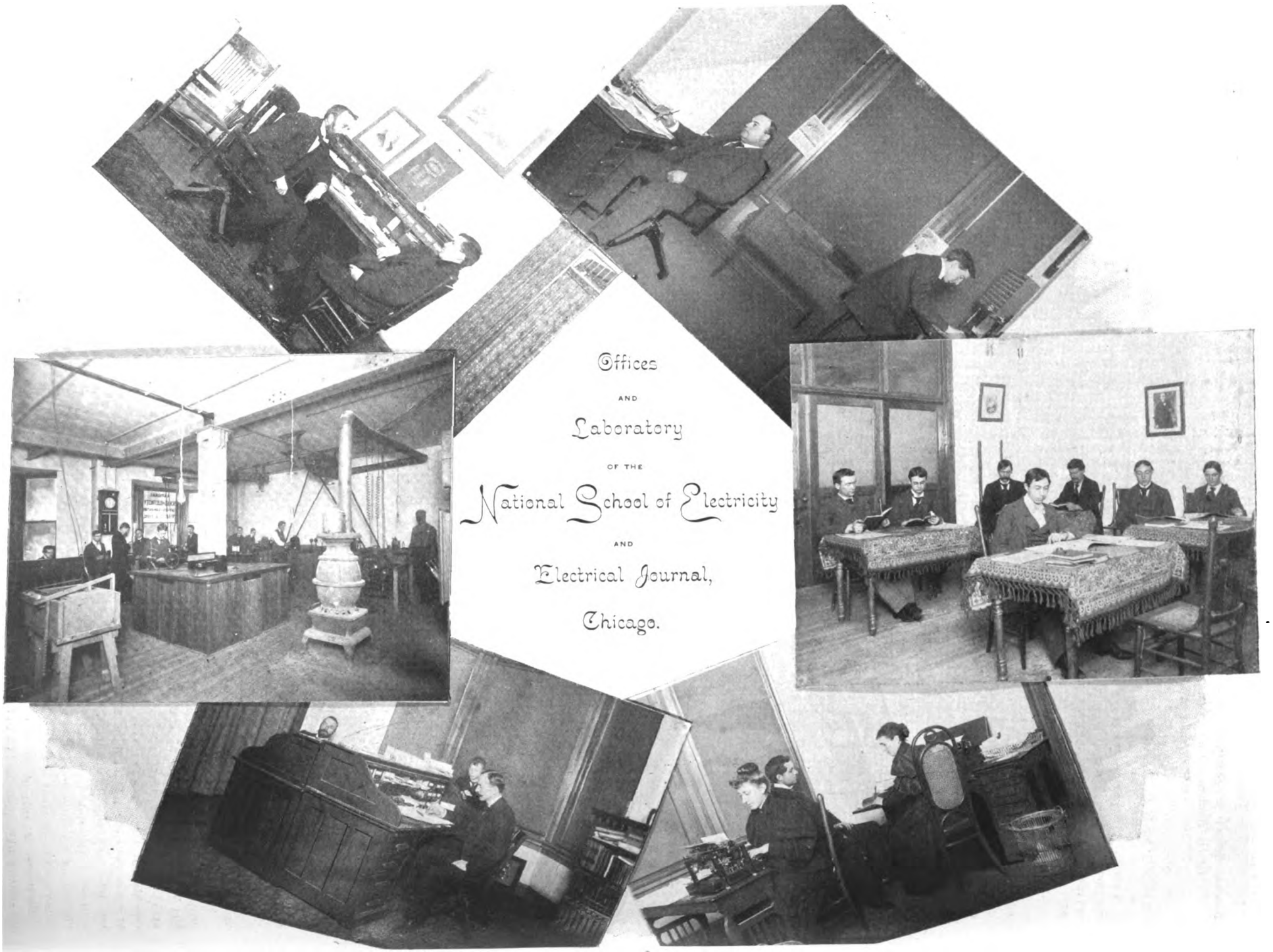

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WELL EQUIPPED LABORATORY.

National School of Electricity Inaugurates a Working Course for Its Students—Construction and Operation of Commercial Apparatus.

CLASSES ARE CONDUCTED DAY AND EVENING.

A very great advance in the work of the National School of Electricity is the establishment at Chicago of a completely equipped laboratory with all necessary adjuncts with which to carry on the teaching of electricity.

Experience for eighteen months in class teaching has demonstrated to the management of the School that there must be some place where advanced students may obtain experience in apparatus building and handling, as well as a complete demonstration of those principles with which electrical workers in every branch of the profession come daily in contact.

This Laboratory occupies a whole floor of space in the new fire-proof building at 331 to 335 Dearborn street, in the heart of the business district of the city, convenient to all the car lines. While the equipment is modest and inexpensive, yet it contains the nucleus of a thorough-going school of practice.

Some views are shown on another page that will give a very faint idea of the employment of the space occupied by the school.

DESCRIPTION OF LABORATORY.

The electrical current for the laboratory use is derived from the Edison Company's direct current service at 220 and 110 volts. The 220 volt circuit operates a ten horse power Western Electric four-pole motor, and this motor in turn drives the shafting to operate the other machinery, consisting at the present time of a machine lathe, buffer and grinder, and a 500 watt 100 volt generator, there being also a base ready laid for planting generators that students are required to wind, operate and test. From this 220 volt current there is also operated a Burton liquid electric forge used by students for metal working, ore reduction and separation, etc. From the 110 volt circuit is derived current for lighting the laboratory, for general experimental purposes, and for operating a motor-generator built specially by the Western Electric Company, and capable of giving out on the generator side direct current at from zero to 1,000 volts or alternating current up to 2,000 volts. Standard measuring and testing, portable and stationary instruments, chemical batteries of various types, sets of commercial apparatus, telegraph, telephone, etc, an electro-plating outfit, metal and wood-working tools, and raw materials of all kinds complete the laboratory as it is at present.

The "Lesson Leaves," originally prepared by the faculty of the school and revised within the past few weeks by Professor Jackson is the text book used; this is elaborated by working directions for students, specially prepared for laboratory purposes.

There is no class work done in the laboratory, each student being instructed individually, although generally two or more students pursue their studies together. All students have access to a rapidly growing library as side reading, and a large room in the center of the building, well ventilated, is devoted to the purposes of a study hall for the students, though on special occasions it is used as a lecture room.

In their work students are expected to study the lesson in the study hall by means of the text lesson, illustrated, and with the help of whatever apparatus is required at their elbow; and afterward they are expected to construct, operate and test original apparatus at their benches and finally to make a complete written report covering the details of the work they have done, how, why, and with what result. These reports give the instructor a full view as to whether the student is completely informed on his subject, and no student is allowed to leave a subject until he knows it in all its bearings.

The course consists of 35 lessons divided into 61 subjects. Students are taken into the laboratory for the full course without reference to time and are compelled to complete the course as shown by written examination before certificates are granted. As many of the students are professional men, merchants, mechanics and engineers, the working hours are fixed to suit the convenience of anyone, the laboratory being open from 9 A. M. until 10:30 P. M. every day excepting Saturday evening. At the present time there are physicians, lawyers and mechanics, engineers, and young men just preparing themselves for business in the laboratory, the professional men being generally interested in electricity as specially applied in their own business.

There are three instructors in the laboratory, one of whom is always present. Some of the students, especially the younger men, have taken up the study of drawing, mathematics, and general physics in connection with their other work.

The tuition fee for the course entire is only $25.00, and for the convenience of those to whom even so small a sum seems large, the fee is divided into four payments 30 days apart, the first of ten, the others of five dollars each.

There are only about fifty students at present in the laboratory, but others will be admitted from a large list of applicants as soon as the work is well methodized.

CURRICULUM FOR THE LABORATORY COURSE.

1.—Experiments with the Electrophorus.
2.—Experiments with Metal Plates showing Induction.
3.—Experiments with the Leyden Jar.
4.—Study of the Induction or Influence Machine.
5.—Make, Test and Operate Primary Batteries and give complete report of same.
6.—Make Plante Cell and report on same.
7.—Experiments in Magnetism:
  a—Make Permanent Magnet from Bar Steel.
  b—Make and Mount Compass Needles—Oersted's Experiment.
  c—Map Lines of Force.
8.—Demonstrate Ohm's Law.
9.—Ohm's Law in Experiments with Divided Circuits.
10.—Measurement of Current by Copper Voltameter.
11.—Law of the Galvanometer.
12.—Measurement of Ohmic Resistance:
  a—By Substitution.
  b—By Divided Wire Bridge.
  c—By Wheatstone's Bridge.
  d—By Fall of Potential Method.
13.—Measurement of Specific Resistance and Conductivity of Various Metals.
14.—Internal Resistance of Batteries.
  a—By Mance's Method.
  b—By Opposition.
  c—With Variable Resistance in Series.
  d—With Variable Shunt.
  e—By Compensation.
15.—Comparison of Electro-Motive Forces:
  a—By Addition and Subtraction.
  b—By Voltmeter.
  c—By Equal Deflections of Galvanometer.
  d—By Compensation.
  e—By Condensers.
16.—Condensers and the Measurement of Capacity:
  a—By Direct Deflection of Ballistic Galvanometer.
  b—By Division of Charge.
  c—By Bridge Method.
17.—Study of Arc Lights.
18.—Electroplating Work.
19.—Construction and Operation of Complete Telegraph Circuit.
20.—Construction and Operation of Complete Telephone Circuit.
21.—Insulation Resistance:
  a—Method by Direct Deflection.
  b—Method by Substitution.
  c—Measurement of Resistance of Wood, Wet and Dry.
  d—Measurement of Various Forms of Glass, Porcelain and Other Commercial Insulators.
22.—Calibration of Ordinary Voltmeter:
  a—By Standard Cell.
  b—By Comparison with Standard Voltmeter.
23.—Winding of Continuous Current Armatures.
24.—Measurement of Armature Resistances.
25.—Measurement of Magnetic Leakage of Dynamo or Motor.
26.—Study of Direct Current Generator:
  a—Magnetization Curve.
  b—Characteristic Curve.
  c—Plotting Curve from Readings on Speed and e. m. f. of Dynamo.
  d—Curves of Series Dynamo.
27.—Test for Regulation of Motor.

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28.—Reliability Test of Voltmeter and Ammeter.
29.—Complete Efficiency Test of Dynamo or Motor.
30.—Photometry.
  a—Test of Incandescent Lamps for Candle Power and Current Giving Efficiency.
  b—Test of Arc Lamp.
  c—Investigation of Absorption and Reflection of Light by Globes and Screens.
31.—Temperature Coefficients of Copper and Carbon.
32.—The Measurement of Copper Plating on a Carbon Rod and its Effect on Resistance.
33.—The Location of Leaks and Faults on Lines.
  a—An Incandescent Circuit.
  b—An Arc Circuit.
  c—On Telegraph and Telephone Circuits.
34.—Experiments with Electro-Magnetic Induction:
  a—Winding and Testing of Induction Coils for Telephone and Medical Purposes.
  b—Winding and Testing of Transformers.
  c—Winding Armature for Alternating Currents.
  d—Changing Commutation of Continuous Current Dynamo so that it will give an Alternating Current.
  e—Magnetization Curve of Alternator.
35.—Testing of Fuse Wire and Other Special Material.

NEW FT. WAYNE MOTOR.

Alternating Motor Up to Thirty Horse Power for Operation on Polyphase or Any Alternating System.

It does one an immense amount of good to visit the Ft. Wayne Shops at Ft. Wayne, Indiana. Smoke is pouring out of every chimney in the factory, every wheel and every belt is turning, every man in sight is at work, and a days' work there now is thirteen hours; in some of the departments they are doing three eight-hour shifts.

The new 125 light arc machines are very handsome and as a result of their introduction the accounting department has a "glad hand" for everybody.

The Ft. Wayne people, Superintendent James J. Wood, and his assistants, are very enthusiastic over the prospects of the new alternating motor now just ready for the market. Superintendent Wood heads his announcement of the new motor with the statement "The Problem Solved at Last," and those who have seen the machine are not disposed to take issue with him on that score.

The first lot of these motors are of ten-horse power capacity each. In the course of shop experimentation, the designs have been so altered that the machine perfected, is a very handsome one. It is a synchronous, single phase motor, but capable of operating on a poly phase system, simply by reducing the connections. It is self starting on full load with maximum running torque. It does not require a special transformer, any ordinary transformer being available. It does not require a starting rheostat to prevent an abnormal rush of current, and of course its installation is the simplest matter, requiring only a location and the attachment of the connections. The company is building at the present time four sizes, 2½, 5, 7½, and 10 horse power. The patterns for sizes as great as 30 horse-power are already perfected.

One of the most satisfactory conditions regarding this new motor is the patent status. They are fundamental in character and are entirely free from litigation, a matter of a good deal of concern to users as well as to manufacturers. A number of the motors are already in use, especially at Niagara Falls.

IT "GOT THERE" WITH EASE.

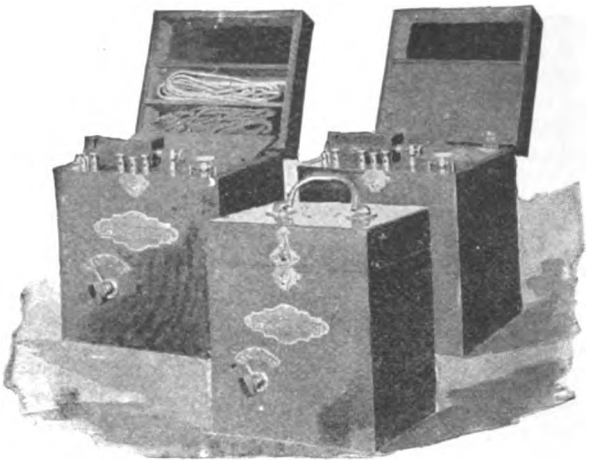
Once again the Lundell Motor has gained notoriety for its superior qualities. This time it piloted to a successful finish the Electric Carriage, (manufactured by Messrs. Morris & Salom, of Philadelphia), which was entered in the recent Motocycle contest held in Chicago. The coveted gold medal was awarded to Messrs Morris & Salom.

Safety, ease of control, absence of noise, vibration and heat and general excellence of design and workmanship were some of the factors which the Lundell machine had to meet, and did meet, successfully.

The Interior Conduit & Insulation Company, of New York, who manufacture the Lundell Motors, are again to be congratulated upon this, the latest popular recognition of the merits of their machines.

THE P. & B. MEDICAL BATTERY.

The P. & B. Battery has many features that recommend it to the busy practitioner. It is in a handsome case, weighs only 17 pounds, and is of a shape that makes it easy to handle. It has practically all of the variations of electrical current that are required in medical practice. It is capable of giving direct or galvanic current continuous in character or the same current interrupted, the interrupter again being capable of rapid or slow interruptions at the will of the operator. It is also capable of giving, by means of the induction coil, an alternating or faradic current of quantity and pressure that make it available for almost any medical purpose. Besides these it is capable of a combination of direct or galvanic and alternating or faradic current for the use of those who require such a combination. The galvanic or direct current is suitable for any kind of cautery work with large or small knives, for the electric light, and for electrolysis and cataphoresis.



The motive power of the P. & B. Battery is six storage cells, properly sealed, each having a capacity of 2¼ volts and 15 amperes; the character of the cells makes the battery absolutely clean and without odor and without power of corrosion as there can be no splashing or escape of fluids. Operated in series, the capacity of the six cells combined is 14 volts and 15 amperes, and taking the average resistance of the human body with skin contacts, at approximately 2500 ohms, the battery is capable of 56 milliamperes, direct or galvanic current. If one of the contacts is a mucous surface, the resistance is decreased approximately one half, consequently the current would be approximately doubled. Where there is close contact and with two mucous surfaces for instance, the capacity of the battery would be much greater, in fact great enough for any purpose for which electricity is used in medicine or surgery. Those physicians who require a large amount of current in the treatment of uterine or ovarian fibroids for instance would have little difficulty in obtaining from 150 to 250 milliamperes, by using a proper vaginal electrode for one contact and a large enough and properly prepared sponge electrode over the abdomen for the other contact. The alternations of the induction coil current are capable of material variation by mechanical adjustment and practically any form of faradic current that may be required can be obtained, excepting, of course, those high frequencies now under experiment by Apostoli and others. As has been said, the battery is capable of producing any form and any quantity of current that may be prescribed in medical or surgical work and where a physician demands simplicity and ease of control, and where he demands that all of his electrical equipment shall be contained in one piece of apparatus, the P. & B. Battery may be safely recommended as having all of the advantages to meet these requirements.

One of the difficulties experienced by the majority of physicians in the use of electricity, is that they are unable to secure the varieties of current that they require quickly, and without trouble, and a still greater obstacle to the use of electricity is the fact that much of the present apparatus requires unusual atten-

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tion. Mr. Porter, in his battery has taken a very advanced step by reducing all these disadvantages to the minimum, as the physician is assured that his current will be ready when he wants it and that without difficulty or an unusually intimate knowledge of the physics of electricity he can get the kind of current he wants.

WORM GEAR FOR ELEVATOR MOTORS.

In a paper on worm-gearing for elevator motors, read in Vienna some months since, Mr. Ernst Egger stated that when worm-gearing was employed for transmitting power direct from the motor shaft to the Orum, it was desirable to use slow speed motors.

Mr. Emil Kolben of the Oerlikon Works disputes this advice. Mr. Kolben states that high-speed motors should be exclusively conducted in conjunction with worm-gearing, if the work is to be commercially practicable and a good efficiency realized. It is from this standpoint that the question is of importance to electrical engineers, since, although no particular difficulties are met with in the construction of motors to run at low speeds, yet the motors are heavy, bulky and expensive, so that the use of such motors in many cases is excluded. As, on the one hand, the employment of worm-gear is regarded with great mistrust, and yet, on the other, this kind of gear is the most important reducing mechanism for electrically-driven tools, cranes and lifts, and for vehicles, Mr. Kolben thinks it right that some facts should be adduced for the benefit of the electrical industry.

Proceeding to deal with this question, the author points out that a great prejudice against worm-gear has hitherto existed, on account of its having been regarded in the old text and hand books as an inefficient means of transmission: and not unjustly so when the method of constructing the gear is considered. After referring to the work in this direction by Profs. Thurstone and Kimbal and Mr. Towne in the United States, and by the late Mr. A. Reckenzaun, who obtained an efficiency of 87 per cent. and subsequently by Mr. Sellers in Philadelphia, the author discussed the efficiency tests recently carried out by Prof. Stodola, of the Zurich Polytechnic, with the ordinary double-thread worm-gear of the Oerlikon Works.

The worm was 3⅛ inches in diameter, had a multiple-ring bearing and engaged with a worm-wheel having 28 teeth, the wheel being of bronze 14¾ inches in diameter. The whole of this gear was placed in oil in a cast-iron box. The gear was coupled to a 20 horse-power electric motor, and the braking tests were made on the worm-wheel shaft. The results were as favorable as in the case previously mentioned. At 1,500 revolutions, a useful performance of 21 horse-power was given on the brake, the efficiency amounting to 87 per cent. The author, who had previously conducted a series of experiments which agreed with the results above cited, is of the opinion that the efficiency with the motor fully loaded will increase even beyond 80 per cent. if the following points are considered in the construction and fitting up of the gear for direct coupling with electric motors:

1. The starting speed should, according to the output, amount to from 20 feet to 40 feet per second, instead of from 7 feet to 16 feet, as has hitherto been customary. This condition necessitates the use, not only of high motor speeds, but also of a large diameter of worm and consequently great distances between the teeth, powerful teeth, and ample bearing surface. By this means the total friction will be reduced. For the purposes mentioned the motors required range from 2 horse-power to 25 horse-power, with usual speeds varying between 1,600 to 800 revolutions a minute. As the elevator drums to be operated, the driving spindles of machine tools, and the car axles of tramcars have speeds of from 140 to 40 revolutions a minute, it is possible to obtain in the most simple manner, without any intermediate gear, the whole speed reduction by means of worm-gearing, with a single or double thread worm having a ratio of reduction of 10 to 1 or 20 to 1.

2. The mechanical production of worm gear requires the greatest care, if it is to be useful for the direct coupling of motors. The worm must be turned out of a solid piece of tool steel, and be tempered, smoothed, and polished. The crown of each tooth should be made of hard phosphor bronze, and if of large diameter it should be drawn hot on to a cast-iron arm crown. The teeth are to be properly cut and polished. The whole gear is to be closed in a box and allowed to work in an oil-bath. This arrangement will reduce the friction coefficient between steel and bronze from 0·00 to 0·005. Gear constructed in this manner runs noiselessly, has only a slight wear, and a life of several years.

3. In order to reduce to a minimum the friction of the whole mechanism on the starting of motors at full load, the pressure is taken up by starting discs arranged on both ends of the worm.

RULES FOR FIRE INSPECTORS.

The National Board of Fire Underwriters has prepared some instructions to firemen and inspectors employed in its service. They refer only to fire hazard and embody the things that should not, as well as the things that should be done. The instructions follow:

1. Have your wiring done by responsible parties and make contract subject to the underwriters' rules. Cheap work and dangerous work usually go hand in hand.

2. Switch bases and cut-out blocks should be non-combustible (porcelain or glass).

3. Incandescent lamps get hot; therefore all inflammable material should be kept away from them. Many fires have been caused by inflammable goods being placed in contact with incandescent lamp globes and sockets.

4. The use of flexible cord should be restricted to straight pendant drops, and should not be used in show windows.

5. Wires should be supported on glass or porcelain, and never on wooden cleats; or else run in approved conduits.

6. Wires should not approach each other nearer than eight inches in arc and two and one-half inches in incandescent lighting.

7. Wires should not come into contact with metal pipes.

8. Metal staples to fasten wires should not be used.

9. Wires should not come into contact with other substances than their designed insulating supports.

10. All joints and splices should be thoroughly soldered and carefully wrapped with tape.

11. Wires should always be protected with tubes of glass or porcelain where passing through walls, partitions, timbers, etc. Soft rubber tube is especially dangerous.

12. All combination fixtures, such as gas fixtures and electric lamps attached, should have approved insulating joints. The use of soft rubber or any material in such joints that will shrink or crack by variation of temperature is dangerous.

13. Electric gas lighting and electric lights on the same fixture always increase the hazard of fire and should accordingly be avoided.

14. An electric arc light gives off sparks and embers. All arc lamps in vicinity of inflammable material should have wire nets surrounding the globe, and such spark arresters reaching from globe to body of lamp as will prevent the escape of sparks, melted copper and particles of carbon.

15. Arc light wires should never be concealed.

16. Current from street railway wires should never be used for lighting or power in any building, as it is extremely dangerous.

17. When possible the current should be shut off by a switch where the wires enter the building when the lights or power are not in use.

18. Remember that "resistance boxes," "regulators," "controllers," "rheostats," "reducers" and all such things are sources of heat and should be treated like stoves. Any resistance introduced in an electric circuit transforms electric energy into heat. Electric heaters are constructed on this principle. Do not use wooden cases for these stoves nor mount them on woodwork.

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HERE, THERE AND EVERYWHERE.

Light and Power.

Ottawa, Ont., is said to have an incandescent lamp for every unit of the population.

London street peddlers are selling incandescent lamps from wheelbarrows, which they trundle about the city.

A cable will be laid under the St. Lawrence River opposite Quebec to provide electric light to the Church of Notre Dame de Leirs.

In Denver, Colo., where wires up to the present time have been indiscriminately hung overhead, an ordinance will be introduced requiring that they be placed under ground.

Experts representing a Scottish-American syndicate are said to have been recently investigating the water power facilities of the Rocky Mountains with a view to utilizing them for generating electric current to be used in Denver.

In Germany there are said to be 7,419 electrical installations, of which 90 are for electrolytic purposes, 453 for transmission of power, and 7,108 for lighting. It is estimated that there are 1,386,000 incandescent lamps and 61,000 arcs.

The water power of the Trent river in Canada is being utilized to develop 1,000 horse-power for generating electric current. It is to supply Trenton and Belleville, the latter situated twelve miles from the generating station.

Alameda, Cal., has gone back to the system of tower lighting. It had been abandoned in favor of the more universal method of individual lamps distributed along the streets, but complaints were made that the city by reason of the few lamps were left in comparative darkness, and the tower system was revived.

The Electric Light and Power Company of Newark, N. J., has voluntarily reduced its price for current from 6½ to 21 per cent. where used for arc lights, five cents per 100 ampère hours for incandescent lamps and ten per cent for power purposes. The reduction is made on the ground that the expense of production has been lessened by a consolidation of their several plants.

The Detroit Street Railway Company has made a proposition to provide light, heat and power to the High School of that place charging them three cents per Kilowatt hour. An obstacle in the way is the rules of the National Fire Underwriters' Association, which in the event of such an arrangement would nullify the insurance. That rule forbids the use of trolley circuits for lighting purposes.

A correspondent of the Press, of New York, advocates the use of a naptha torch instead of electricity in the outstretched hand of the Statue of Liberty in New York harbor. It could be made, he says, to produce a flame fifteen feet in height, and by its flame and the liveliness of its color would much more closely approach the conception of the statue than can be achieved by the use of electric lights.

The Lachine Rapids Hydraulic and Land Company of Montreal, which will utilize the falls of the Lachine Rapids to generate electric current, has come into possession of controlling interests in the Citizens' Light and Power Company and the Standard Light and Power Company; this will give them a market for their current as soon as they are ready to deliver it. The plans of the Lachine Rapids Hydraulic and Land Company were published in a recent issue of THE ELECTRICAL JOURNAL.

The Mining Industry and Review makes this answer to the query, "how can one determine the horse power of any stream of water"?

"Multiply the head in feet by the number of cubic feet of water used each minute, and that product by 65½, and divide the product by 33,000, will give the nominal horse power. Before planning any plant to use water power, one should obtain the advice of a competent engineer in water powers, as there are some difficult points to determine in this apparently simple problem. The determination of the volume of water, the adaptation of a wheel to existing conditions, and the actual and not theoretical power available, are all questions requiring good special skill for determination."

Railways.

The Newark and Granville Electric Railroad Company has made special rates to school children. Tickets for one round trip each day, good for one school month are sold for $1.00, practically making half rates.

It has been figured by the statistical fiend that the present street car service of Chicago, if performed exclusively by horses would require 30,000 horses, which would eat annually 5,46 ,000 bushels of oats and 1,000,000 tons of hay.

There are now 13,176 miles of street railway in the United States, an increase of 3,500 over the number in operation in 1891. Of the present total, 409 miles are operated by steam, 578 by cable, 1,950 by horses, and 10,238 by electricity.

The London Electrician has awakened to the belief that in the necessary changes from horses to electric traction, if done "in a reasonably careful and honest way," net earnings will increase in greater proportion than the cost per mile of road.

Cincinnati claims to have one of the best street railway systems in the world. Electricity is the only motive power used excepting for about twenty-four miles which is operated by cable. The total track mileage is upwards of 217 and 1,157 cars are in operation.

The several street railway companies of Brooklyn have filed applications with the Secretary of State at Albany for extensions to their systems aggregating something like 200 miles of track. Many of the projected lines run through some of the finest residence streets of the city.

A statement filed on the 6th inst., with the City Treasurer of Milwaukee shows that the gross receipts of the Milwaukee Street Railway Company for the past year have been $1,286,880. The figures form a basis upon which a city tax has to be paid by the company amounting to $21,987.

Mt. Airy, Ohio, is agitating for the extension of the Cincinnati Street Railway lines to that place and offers to guarantee 400,000 passengers a year for two years in consideration of a double track and a fifteen minute service. It is estimated that the outlay would be $100,000 and that the venture would pay six per cent. on the investment over and above expenses of operation.

An electric safety appliance has been patented and successfully tested on the Watertown branch of the Fitchburg Railway. Its purpose is to give warning and to bring a train to a standstill in the event of approaching an open switch or other obstruction. The engine is equipped with a small dynamo so constructed that when there is anything the matter with the rails it is set in operation and the brakes are applied immediately.

The West End Street Railway Company of Boston submits a statement to October 14, 1895, showing that during the three years ending at that time 347 persons came into collision with their cars. Out of this number 301 escaped unhurt or received only slight injuries. Forty were more seriously injured while only six persons were killed, or a percentage of 1.7 of the total 347. During these three years the company's cars ran 52,700,000 miles making a car mileage of 8,783,333 for each fatal injury. This remarkable record in a crowded city like Boston is attributed to the use of an efficient fender.

The City of Chicago has an ordinance which provides for an annual license of $50 for each street car, whether in use or not. The ordinance, however, has been a dead letter and the license has never been collected. Mr. Bonney, vice president of the Chicago General Railway Company, with a view to testing its validity, has offered to admit that his company has been operating car No. 15 for the past three years without the license mentioned, and that there has not been posted in the car, as provided by law, a certificate of such license. The corporation counsel has not yet signified whether he will press the suit or not.

£100,000 is said to represent the cost of a November fog in London in the form of gas and electric light accidents, delays and damage.

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ELECTRO-THERAPEUTIC DEPARTMENT.

ELECTRICITY IN NERVOUS DISEASES.

Dr. Peterson, in the Belfast Medical Journal for November, 1895, gives the following very interesting résumé of the present status of electricity in nervous and mental diseases:

We may treat paralysis and spasm by electricity. In paralysis the distinction between the two classes of disorders by the situation of the lesion in the cerebro-spinal or the spino-muscular segment of the motor tract is to be remembered. Since in the former the nerves and muscles react to faradism and suffer no trophic disturbance, the indication for electricity is almost entirely to assist in the prevention of spasmodic contractures. Hence the exercise of the rigid muscles by faradism is useful. The other form of paralysis, which we may call peripheral, requires faradism if the affection is so mild that the muscles still react to this current. Galvanism is also useful in addition because of its nutritive effects upon the partly degenerated nerve and muscle. If, however, the peripheral paralysis is severe, faradism is of no value, since the muscles cannot be exercised by it, and it has little or no effect upon nutrition. Here galvanism should be used, not only for its value as a trophic agent, but also to exercise and strengthen the muscles by producing contractions.

Clonic spasm, such as tic convulsif and blepharospasm, may occasionally be improved by the use of the anode, (best conjoined with cocaine by cataphoresis) over the affected muscles and nerves, the cathode being placed upon any remote part of the body, like the hand, back or breast.

Tonic spasm, such as torticollis and writer's cramp, may also be relieved to some degree by anodal galvanization. In any form of spasm usually only the most recent cases are susceptible of mitigation or cure by electricity. In hysterical paralysis or spasm, strong faradization and static electricity are of great value.

An irritative or destructive lesion of any part of the sensory tract, from the cortex to the peripheral filaments, produces in the one case hyperesthesia (pain, neuralgia) and in the other anesthesia. Pain and neuralgia require anodal galvanization; and in pains or neuralgias of superficial nerves (trigeminal, intercostal, and the like) the use of solutions of cocaine of from 10 to 20 per cent. with the anode is indicated. In all such applications for the relief of pain the electrode should be held steadily at one spot (the anode on the painful part, the cathode at any indifferent point), and the current gradually diminished at the end of from ten to twenty minutes without interruption of any kind. Trigeminal, cervico-occipital, cervico-brachial, intercostal, lumbar, or sciatic neuralgia and rheumatic pains (like lumbago, headache, and migraine) are all to be treated upon this principle.

Anesthesia, on the contrary, is best alleviated by faradization and the faradic brush. The anesthetic area should be tapped with the brush with a current strong enough to be painful upon one's own hand. The skin should be dry and if necessary made more so by the use of chalk or powdered starch.

In organic diseases of the brain and spinal cord, and in insanity, electricity is of doubtful service. Any value it may possess is probably due to psychic suggestion. But even such powerful suggestive agency is not to be despised. In some functional central diseases, such as neurasthenia, railway brain and railway spine (traumatic neuroses), hypochondriasis, and the like, general or local galvanization and faradization are often of considerable service.

After the above preliminary remarks on the general indications, the author presents an alphabetical list of neurological conditions in condensed form, with the electrotherapeutic procedures advisable in each, as follows:

Abducens paralysis.—See Oculo-motor palsies.

Abdominal neuralgia.—Stabile galvanization from the back to the abdomen.

Amyotrophic lateral sclerosis.—Galvanism to the spine and to the atrophied muscles.

Anesthesias.—The faradic brush with the current strong enough to redden the skin.

Asphyxia.—The faradic brush to the epigastrium, neck, face, nostrils, or the interrupted faradic current to the phrenic nerves.

Aphonia (hysterical).—Faradism with one pole on each side of the larynx.

Ataxic paraplegia.—Galvanism to the spine; faradism to exercise the rigid muscles.

Basedow's disease.—Stabile galvanization with the anode over the great nerves in the side of the neck and the cathode between the shoulders.

Blepharospasm.—Anodal galvanization at the outer corner of the eye (10 per cent. cocaine cataphoresis sometimes useful).

Brain, organic disease of.—Electricity useless, except a mild galvanic current only and without interruptions as a placebo.

Bulbar paralysis.—Faradism or galvanism as needed to contract the muscles of the tongue, lip, or pharynx.

Bell's palsy.—See Neuritis.

Catalepsy.—The faradic brush to the surface of the body; phrenic faradization.

Cephalalgia.—Stabile galvanization of the head; the static breeze.

Cervico-brachial neuralgia.—Stabile anodal galvanization over the painful nerves, the cathode on the back or in the hand.

Chorea.—Faradism useful to exercise the muscles, which are sometimes paretic, but only after the choreic movements have ceased.

Coccygodynia.—Stabile anodal galvanization at the coccyx with the cathode on the abdomen.

Contractures.—Faradization of motor points to exercise the rigid muscles, and especially their opponents.

Deltoid paralysis (circumflex nerve).—Faradism to exercise the muscle.

Depression, mental.—General faradization.

Dyspepsia, nervous.—General faradization and faradic baths.

Diphtheritic paralysis.—Exercise of muscles with the faradic or galvanic current, as required, at motor points.

Enteralgia.—See Abdominal neuralgia.

Exophthalmic goiter.—See Basedow's disease.

Enuresis nocturna.—Sometimes relieved by vesical faradization with one electrode on the symphysis, or one urethral electrode introduced into the bladder, the other applied to the sacrum; moderate current, with interruptions.

Erb's paralysis.—Faradization or galvanization, according to the reaction, at motor points, to exercise the affected muscles.

Facial paralysis.—See Neuritis.

Facial tic.—See Spasm.

Gastralgia.—Anodal galvanization of the epigastrium, with the cathode on the back.

Genital neuroses and psychoses.—General faradization.

Hallucination.—Galvanism and faradism have been known, in a few cases, to stop hallucinations of sight and hearing, probably by suggestion; the poles to be applied to the affected organs.

Headache.—See Cephalalgia.

Hemicrania.—See Migraine.

Hemiplegia.—Faradism to exercise the muscles and prevent contractures; the faradic brush in the presence of hemianesthesia.

Hypochondriasis.—General faradization.

Hysteria.—Faradism in paralysis and contractures; the faradic brush in anesthesia; general galvanization sometimes useful; the static current for suggestion.

Locomotor ataxia.—Galvanization of the spine employed usually, but of no actual benefit; anesthesia to be treated with the faradic brush; lightning pains with the galvanic anode (occasionally cocaine cataphoresis.)

Lumbago.—The faradic brush for counter-irritation; the galvanic anode to the painful region.

Melancholic stupor.—General faradization.

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Migraine.—Galvanism with one pole on each mastoid process; stabile, from five to ten minutes.

Mastodynia.—Anodal galvanization of the painful spot, the cathode on indifferent point.

Multiple spinal sclerosis.—Galvanism is used, but is of no actual service.

Musculo-spinal paralysis.—Faradization of motor points if the extensors react; otherwise galvanism, with the cathode to contract the muscles and improve nutrition.

Myelitis.—Galvanism of the spine; faradism to spastic muscles; the faradic brush for anesthesias; the galvanic anode for pain; the cathode or anode for atrophied muscles.

Neuritis, multiple, alchoholic, arsenical, lead, meta-diphtheritic, rheumatic, and the like.—If the muscles react to faradism, exercise them with that current; if not, use galvanism; labile galvanization to improve nutrition.

Neuralgia.—The faradic brush is occasionally useful over the painful region, but the stabile galvanic anode is the best, and when superficial nerves are affected, cocaine cataphoresis (a 10 to 20 per cent. solution).

Neurasthenia.—General faradization or galvanization, or the static current for suggestive purposes.

Neuroma.—When superficial, cocaine cataphoresis.

Oculo-motor palsies.—A sponge anode over the eyeball, mild stabile galvanization.

Pianist's cramp.—See Professional neuroses.

Phrenic-nerve stimulation.—Both sponge electrodes to the two phrenic-nerve points, or one over the nerve and one at the epigastrium; faradic current, interrupted every two or three seconds.

Pleurodynia.—Stabile galvanization, with the anode to the painful point, or the faradic brush to counter-irritate.

Poliomyelitis.—Labile galvanization to improve the nutrition of atrophic muscles, and to exercise them.

Progressive muscular atrophy.—Galvanism to improve the nutrition and exercise the atrophied muscles.

Professional neuroses (writer's, pianist's, compositor's, and the like).—Faradism to exercise the muscles; galvanism to improve the nutrition.

Pseudo-hypertrophic paralysis.—Local galvanization and faradization of muscles.

Ptosis.—See Oculo-motor palsies.

Sacral neuralgia.—See Neuralgia.

Sciatica.—A large, flat sponge anode over the painful points, with the cathode as far away as possible; stabile galvanization; a steady, strong current, without interruption, for fifteen minutes daily in recent cases. In old cases electricity is of little value.

Spasm.—Electrical treatment of the cause (neuritis, neurasthenia, hysteria, peripheral irritation and the like); the galvanic anode to the nerve involved and over painful points. Cocaine cataphoresis is useful in superficial nerve spasms (blepharospasm, facial tic, and the like).

Spinal-cord diseases.—Spinal galvanization; a steady current, as strong as can be borne (from ten to fifteen milliampères), without interruption; either pole at the nape of the neck and the other on the lumbar region. The distinction between ascending and descending currents in the treatment of chronic diseases of the spinal cord is altogether absurd. The only value of electrical treatment in such cases is probably psychic.

Syncope.—See Asphyxia.

Syringomyelia.—The faradic brush to anesthetic areas; galvanism to exercise and improve nutrition in atrophied muscles. See also Spinal-cord diseases.

Spinal-irritation.—The faradic brush along the spine; general faradization.

Singultus.—Faradization of the phrenic nerve. See also Asphyxia.

Tabes.—See Locomotor ataxia, and Spinal-cord diseases.

Telegrapher's cramp.—See Professional neuroses.

Third-nerve paralysis.—See Oculo-motor paralysis.

Tic douloureux.—See Neuralgia.

Torticollis.—Labile anodal galvanization of the affected muscle.

Trigeminal neuralgia.—The anode over the painful point (with a 10 to 20 per cent. solution of cocaine); the cathode between the shoulders or in the hand; no interruption; fifteen minutes; fifteen milliampères. See also neuralgia.

Vesical paralysis.—See Enuresis nocturna.

Vomiting (hysterical and nervous).—Stabile anodal galvanization of the epigastrium, with the cathode on the back.

Wrist-drop.—See Neuritis, and Musculo-spinal paralysis.

Writer's cramp.—See Professional neuroses.

Wry neck.—See Torticollis.

LESIONS OF FATAL ELECTRICAL CURRENTS.

The Journal of the American Medical Association gives an abstract of a recent report made by Dr. Kratter on this subject, to the Styrian Medical Society. The case was that of a workman who was killed by a shock received while he was occupied in stringing telegraph wires. Post-mortem examination, performed twenty-one hours after death, showed a ruptured blister on the left forefinger, marked rigidity and intense ecchymosis on the dependent parts of the body. There was also hypervenosity of the blood, venous engorgement of the lungs, extravasation of blood into the common sheath of both the carotid arteries and the vagus nerve, and symmetrical hemorrhage along the spinal chord. When an electric current of 1,500 volts acts upon rabbits some of the animals live, and others show typical symptoms such as tetanic contraction of all muscles and instantaneous stoppage of respiration, the heart, nevertheless, continuing to act. There is also sometimes found disorganization of the brain, with destruction of the peripheral parts of the cortex and intracranial effusion of blood. The stoppage of respiration lasts half a minute. From these experiments it results that the first effect consists in permanent or temporary arrest of respiration. Death from electric shock is, therefore, a form of suffocation, and persons who meet with such an accident should be treated by artificial respiration, as in ordinary cases of suffocation.

ACETYLENE—THE NEW GAS.

Chicago Gas Company Secures State Rights for Illinois and Wisconsin.

The United States Acetylene Liquefaction Company of New York which controls the patent process for manufacturing and selling Acetylene, the new luminant, has sold the Illinois and Wisconsin rights to the Chicago Gas Company. The consideration is said to have been $600,000. It is claimed on behalf of the new luminant that it is very much more brilliant than either gas or electricity and does not cost as much as either. It is capable of being liquefied and can be handled and sold the same as kerosene, excepting that it is sold by the pound instead of by the gallon. It is stored in steel cylinders six inches in diameter and four and one-half feet long. As soon as the valve is opened the gas begins to generate and it is said that a cylinder containing twenty pounds will last about three months in the average residenee. A strange feature of the article is that upon exposure of the liquid to the air it immediately turns to ice; while in the cylinder, however, neither heat or cold affects it. The gas burns steadily and without smoke or odor.

AMPÈRE'S BLACKBOARD.

Ampère, like other philosophers, was noted for his absent-mindedness, says the London Electrical Engineer. It is stated that on one occasion while walking along the street he mistook the back of a cab for a blackboard, and as a blackboard was just the thing he needed at the time to solve a problem which had been vexing his mind for some moments during his walk, he made use of it. Taking a piece of chalk out of his pocket he proceeded to trace out a number of algebraical formulæ on the cab's back, and followed the moving "board" for the space of a quarter of an hour without noticing the progress of the conveyance.

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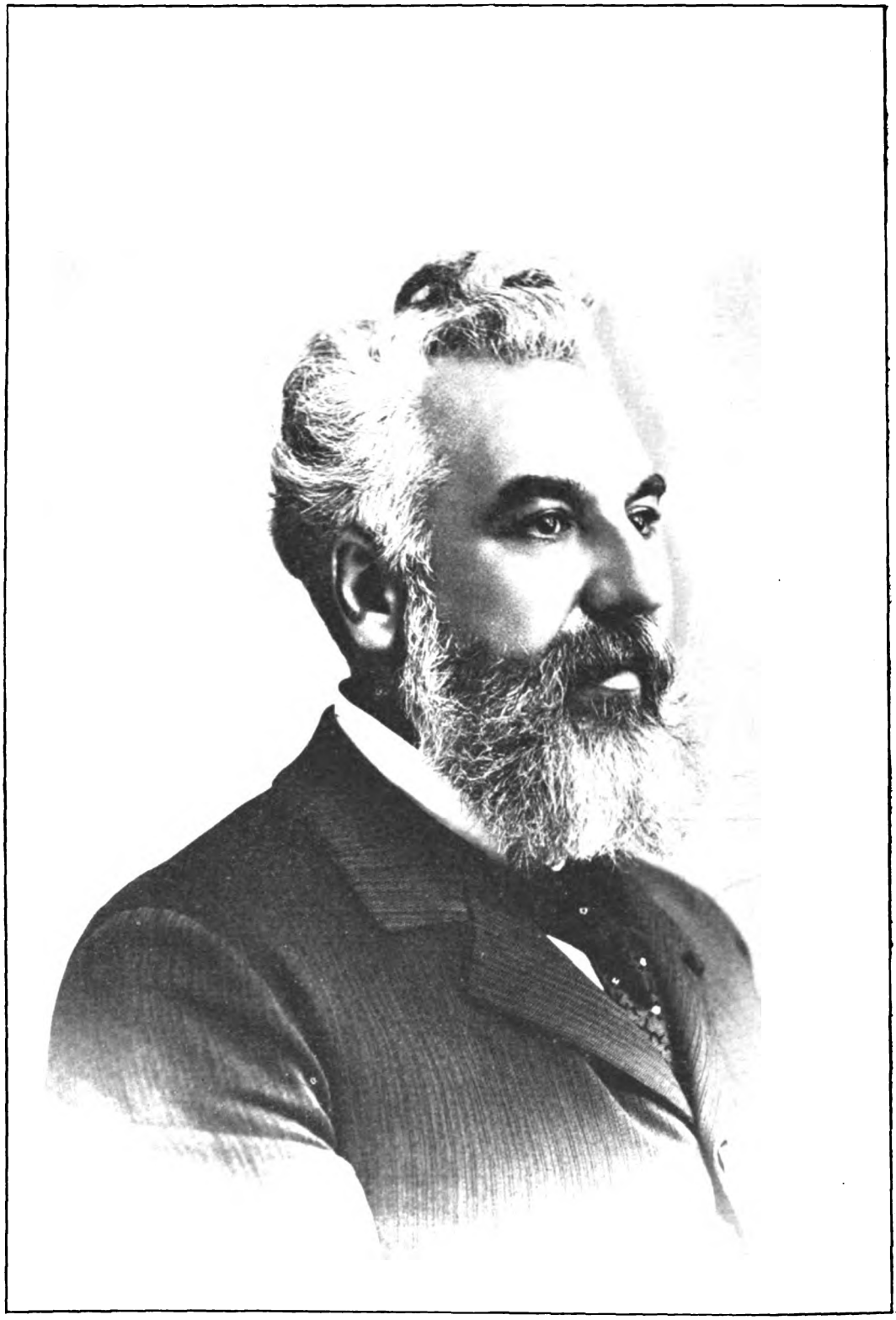

ALEXANDER GRAHAM BELL.

Born at Edinburgh, 1847. Discoverer of the Principle of the Telephone.

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The Electrical Journal.

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STORAGE CELL IN COMMERCE.*

Auxiliary Batteries Practicable for Four Kinds of Service. For Annex Stations, Peak of Load, Minimum Hours, and as Equalizer.

LITIGATION OVER AND PROSPERITY ASSURED.

To those interested in selling electricity, it is a source of great satisfaction that the storage battery discussion has, within the past few months, especially in America, taken on an entirely new phase. It has become a question of use, and not of manufacture.

For years we have all watched with great interest the various types of batteries put upon the market. We have discussed their value, at first confining ourselves as to whether they would work at all, and in later years broadening out the discussion as to how well they would work. We have watched the various companies interested in the manufacture of storage batteries fight one another in the courts, and we have wondered if it were ever to be possible to obtain a battery which did not infringe some one else's patent.

Until very recently it has not been possible to discuss from the standpoint of experience the economic merits of storage batteries, and it is particularly satisfactory to us to note that the discussion seems to have drifted away from the manufacturer to the user. To-night I am going to assume, at least for the purpose of this communication, that these perplexing questions have all been answered, and that we are finally on a par with our neighbors across the water, prepared to discuss the advantages of a commercial storage battery found ready to our hand.

Whatever may be the facts as to the existence of a commercial battery, some of us have purchased and are operating batteries which we consider satisfactory, and I will leave that part of the discussion to others, confining myself exclusively to their uses in an Edison system of circulation and distribution for lighting and power purposes, in thickly settled communities. As it appears to me, their uses can be classed under four great heads, as follows:

1st. To carry the peak of the load at maximum hours.
2nd. To carry the entire load at minimum hours.
3rd. To act as an equalizer or reservoir.
4th. For the equipment of annex stations.

There are many other special uses for batteries which can be naturally classed under one of these heads.

First, to carry the peak of the load.—In all systems of lighting, whether by gas or by electricity, there is a considerable portion of the connected load which is used only for two hours per day during the three or four months in winter. We have all of us, at various times, very earnestly discussed the probability of being able to widen out this peak as it is commonly known, and numerous schemes have been devised by which it has been made more or less of a hardship for customers to use their light at this time, special concessions being made at all other hours of the day or night. It does not seem to me that any of these will avail. We cannot get around the fact that there are, in every large city, hundreds of stores that close up at six o'clock at night. The only need which they have for light is after it becomes dark. In this section of the country, darkness comes on about 4.30 in mid-winter, and these stores are bound to use their light from 4.30 to six o'clock, and have no need of it at any other time. These are facts which are entirely outside of the question of electric lighting, and nothing which we can do will change them.

It matters not whether the company has a large motor load in the daytime, or a large city contract at night. These are simply going to change the height of the curve at those hours. They are not going to alter the special shape of the curve due to the hour and a half of darkness during the business day.

This particular peak will be in some cases a much larger percentage of the total maximum output of the station than in others, but I think it is safe to assume that it is likely to vary only between one-third and one-half of the total. In the case of the company with which I am connected, we have found that if we divided our maximum load of the year into two parts, the upper half exists only for about two hours under ordinary circumstances, and four hours under exceptional circumstances for the five winter months.

Computing the kilowatts in these two halves, we find that the lower half contains 90 per cent. of the K. W. hours manufactured, whereas the upper half contains only about 10 per cent. This would prove the position taken by some engineers that if an extremely large station was to be constructed, it would probably pay to equip it with two types of apparatus—50 per cent. to be of the best economy and most expensive class known to the art. This to do the 90 per cent. of the work. The other 50 per cent. to consist of crude, cheap, uneconomic but reliable apparatus, to do the 10 per cent. of the work. The saving in interest on the lesser investment in the second class would be much greater than the extra cost of running this half, due to its poor economy.

In our particular case we find ourselves in precisely this position. Our company installed in years past about 4,000 H. P. of high speed, belted, bipolar apparatus, reliable but of poor economy. Some three years ago it changed to the other extreme and commenced to equip with the highest priced and most economical apparatus to be found in the market, and to-day there is about 4,000 H. P. of this apparatus in use.

The data which we have for 1894 and 1895 proves the statement which I have just made. Ninety per cent. of our kilowatts have been manufactured by the vertical, triple expansion, multipolar units, and yet the total capacity of this apparatus is not over 50 per cent. of our maximum output for the winter.

The application of the storage battery to these conditions is obvious. What we need and what all companies under generally like circumstances need, is a piece of apparatus capable of doing two hours' work per day which is cheap, and which has fair economy. If storage batteries could be used under no other circumstances than these, it is, perhaps, somewhat doubtful whether it would pay to install them, but yet I am inclined to think that

*Paper by C. L. Edgar, read before the American Institute of Electrical Engineers at its 101st meeting.

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considering their first cost and the efficiency which we can obtain from them, it could be fairly proved that it would pay to use them rather than what I have designated as the cheap type of apparatus.

At the time our first battery was purchased, our standard unit was 650 H. P. We therefore called for a battery of 650 H. P. capacity for two hours. We eventually, under stress of circumstances, reduced this to one and a half hours and found that it cost considerably less than a first-class steam plant.

As all apparatus has to be installed for the express purpose of taking care of the maximum load, it seemed to us very clear that if we could save in our first investment by installing storage batteries which cost less than the steam plant, we were going to be able to do a given amount of work with a less amount of capital by this means than by any other. We thus decided to install a battery to take care of the peak, even if we obtained no other advantage from it.

Second, to carry the entire load at minimum hours—I think that the nature of the load curve in America is against the use of batteries for this purpose to anything like the same extent as abroad. With us there is only about six hours of minimum load, whereas, owing to the lack of motor business in Europe, the minimum there extends some days from midnight until three o'clock in the afternoon, Our minimum is so short that we are not able to save one shift of men nor are we able to save much in the fixed boiler room expenses from drawing the fires, banking the boilers, or any of the various other expedients used when the plant is not in operation.

Our generating department has gone through some exhaustive experiments, running first the engines for 24 hours a day, charging the battery at minimum load, and then turning around the next week and shutting down the steam plant for the six hours from midnight until six o'clock in the morning, and depending entirely upon the battery. The general conclusion seems to have been arrived at that the former is the cheaper method. Admitting this, the indirect advantages of the former, by which the battery is charged during the night, and can be used during the following day, are very much greater than if the battery were discharged during the night, as it could not be completely charged again until the middle of the afternoon of the following day.

I do not consider our conclusions final, as the local conditions might materially change the result. In our case it happens that the output at night plus the charging current of the battery, is just equivalent to one of our standard units. If it were necessary to run two units to do this work, our conclusions might have been different, so that I think this is a case which has to be decided in each place on its own merits.

Third, to act as an equalizer or a reservoir.—It is this use of the battery with which we have been particularly pleased, and in order to understand, it is perhaps desirable to explain the needs which a modern station has for apparatus of this kind. Years ago a distribution company was equipped with one station, furnishing electricity through a system of feeders supplied from one 'bus bar. All this is changed. To-day the modern station manufactures electricity in various places, transfers it from one station to the other at will, sends it out through a system of distribution at three or four pressures supplied from 'bus bars of varying potential. At the minimum hours of the day the electricity is manufactured by one set of dynamos, part of it being delivered to the 'bus bar in the station in which the dynamos are located, the remainder being sent out over tie lines to various annex stations and delivered there to the local 'bus bar. The amount of current is so small compared with the capacity of the various circuits that, practically the pressure delivered at the lamps is constant, notwithstanding the various roundabout ways in which it reaches them.

As the load begins to increase, the drop over the tie lines becomes noticeable, and it is necessary, by means of auxiliary dynamos known as boosters, to raise the potential of that part of the output which is delivered to the tie lines.

The load still increasing, it is necessary to start additional dynamos. These may be thrown in multiple directly with the original pair, and deliver the same potential as the others, or, if the condition of the load warrants it, they may be thrown in multiple with the original dynamos and the booster in series, and deliver the potential needed by the tie line. In this case the booster might be taken out of circuit.

The load on the tie line again increasing, the booster would be again put in use, and we would thus have the condition of a tie line supplied partly by a dynamo of the proper potential, and partly by additional current furnished by a booster, raising the potential from another 'bus bar supplying current locally.

This goes on until nearly the maximum load is reached. It then may be found, as it is sometimes in our case, that the original or main station is not equipped with sufficient dynamos to supply the local distribution. In this case the current over the tie line is reversed, and the annex station sends current to the original station, which arrives there at somewhat lower potential than is needed, and is there raised by means of a booster to the 'bus bar of that station. It is necessary to understand that these are every day occurrences, and if we were not equipped with a battery, it would be almost an hourly question as to what it was necessary to do next, whether to start dynamos, stop them, change boosters or any other of the innumerable combinations which might be made. This trouble is intensified by the uncertainty as to what changes are going to take place in the output, and what the load is going to be at any given time. In a very large degree the battery answers all these questions or at least makes them unimportant. It makes it possible to determine beforehand what the regular day's work of the steam plant is to be, to decide how many and at what time boilers are to be put in service, when engines are to be started or stopped, and in general to operate the plant to its best economy, knowing that daily or hourly inequalities in the load, or uncertainties caused by the weather will be taken care of by the battery.

It is kept in multiple with one or the other or all 'buses at all times. It is supposed, for many hours of the day, to be standing idle with the ampere-meter at zero, but it may, without a moment's warning, be called upon to either give or take anywhere from one to 3,000 amperes on a side. It is possible in this way theoretically to keep every engine which is running, loaded up to its maximum economy at all times. Practically we have found it possible to never operate an engine with less than three-quarters load. The economy of the steam plant then more nearly approximates what is known as mill practice, which is the goal towards which we are all striving.

Having satisfied ourselves in the beginning that with a given amount of capital we could do more work with the battery than without it, we by actual practice came to the conclusion that we could by the same means do this same amount of work more cheaply. When we remember that we installed the battery for the express purpose of taking care of the maximum load, we are, of course, particularly pleased at the very great use we can make of it for this purpose of equalization, and yet, in addition to this, we have made enough tests to prove to our own satisfaction that we do not lose anything in fuel economy by this particular use of the battery. The watts lost by the inefficiency of the battery are made up more than fourfold by the better economy of the steam plant. We have taken typical winter days and figured out exactly the cost of running our system with the battery and without, and have proved that the actual coal consumed with the battery is a material amount less than without it. If, in addition to the fuel, we take into account the very great saving in the labor, the added reliability and the better service given, we will see that these uses of the battery are even greater than those for which it was originally installed.

I do not think it is possible to overestimate the advantages of storage batteries for the purpose of giving regularity and reliability to a system of distribution. With very sudden

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fluctuations in the load which are continually taking place, it is almost impossible with dynamos alone to regulate the 'bus pressure so quickly that the pressure throughout the system remains constant. Of course, we have done this for years to the best of our ability, but it has necessitated keeping everything in first-class shape and having the employees of the company on the alert at all times to take care of this question. The uses of the battery very much simplify this problem. Very many times where in the past it was necessary to change the magnetism of the fields of dynamos, it is now necessary to do absolutely nothing, the battery acting as a reservoir, giving out quantities of current without any apparent change in pressure for the time being.

This question of regularity is very closely connected with the one of reliability. To those of us who are identified with central station work, there is a great sense of security when we realize that whatever may happen to the steam plant, we have sufficient battery to carry us over a few minutes of disorder. In our particular case, we have at the present time sufficient battery to run 60,000 lamps for five, ten or fifteen minutes, depending upon how great the emergency is. This advantage of the battery may not appeal to an outsider. I do not think they can realize the intense nervous strain to which all connected with the successful detail operation of the station are subjected. If a battery and a steam plant were on a par in all other respects than this, I should personally feel very much inclined to install it for this reason alone.

Fourth, for the equipment of annex stations. This is a use to which we have looked forward with great interest, but up to the present time have had no occasion to make the use. There are in every city certain sections, located so far from the centers of distribution that it becomes a very serious and expensive matter to reach them with the regular three-wire system.

When we realize that it makes very little difference to which end of a tie line a storage battery is connected, we can see at once the special advantage which this type of apparatus gives us. If of such value that it will pay to install them, it is a matter more or less immaterial whether they are installed at the main station, or at an annex station connected to the main station by tie lines.

The fixed charges of running a battery room are very small as compared with those of a steam station, and there would not be any very material increase of fixed expense between one large battery located in a central point and half a dozen small ones distributed throughout the city.

Storage batteries, therefore, lend themselves particularly to the location of a "central" station at some convenient point upon the water front, and the building up of small centers of distribution scattered throughout the city, consisting of storage batteries with or without a steam adjunct, and connected together possibly, but certainly each one connected to the central station.

This communication may be considered to have been written upon very narrow lines and I may say that this was intentional. So much has been written during the past few months upon generalities and upon possible cases which may or may not exist, that it is sometimes valuable to brush these all one side and to confine oneself to some specific cases. This I have tried to do.

Our company has used the first battery 20 months, and one of double its capacity for six months, entirely too short a time to come to any conclusions about the depreciation, but it has given us ample time to satisfy ourselves as to the economic value. It is sufficient for me to say that if a need should arise to-morrow for additional capacity, either at our main station, at either of the annexes, or in any new part of the city, within reasonable distance of our center of distribution, we should consider the question along the lines which I have just indicated. We should eliminate entirely from the discussion the question which has distracted the public mind for so many years and decide it entirely upon its merits.

FUNCTION OF ACCUMULATORS.*

Eight Uses for Storage Batteries in Electric Lighting—Economy in Practice.

The function of accumulators is to receive electrical energy at one time or place, and to give it out at some other time or place.

The principle uses to which they may be put in electric lighting are the following:

1. To supply portable electric lamps.
2. To take up fluctuations and thus steady the voltage or current.
3. To furnish energy during certain hours of the day or night and enable the machinery to be stopped.
4. To aid the generating plant in carrying the heavier load which usually exists for only an hour or two.
5. To make the load on the engines more uniform by charging the battery when the load is light.
6. To transform from a higher to a lower potential by charging the cells in series and discharging it in parallel, or *vice versa*.
7. To subdivide the voltage and enable a three or a five-wire system to be operated with a single dynamo.
8. To supply current from local centers or sub-stations.

Each of these applications will be considered separately in above order.

1. *Portable accumulators.*—The accumulator is practically the only means of supplying portable electric lamps or those which are not connected to a dynamo even if they are stationary.

The primary battery is expensive and troublesome to operate, and it has never been commercially successful for electric lighting, except where only a few small lamps are required. Nor is there any other satisfactory primary source of electrical energy except the dynamo driven by mechanical power. It is therefore practically essential to adopt accumulators wherever portable electric lamps are used.

The serious drawback with portable accumulators is their great weight. For example, a standard size which weighs 100 pounds, yields ten volts and five amperes, or 50 watts for ten hours, which is just sufficient to feed one ordinary incandescent lamp of 16 candle power. This weight would be prohibitive in most cases in which the only way to carry the battery was by hand, but it might be allowable for lighting railroad trains, where the weight would not be so objectionable.

Their great weight would also discourage in most instances the use of accumulators for supplying lamps in places which are not connected to a generating plant, the batteries being carried back and forth from a charging station. This method might be resorted to on special occasions, such as a fete, to which ordinary commercial limitations do not apply, but for regular lighting it wonld be troublesome and expensive.

Small accumulators are used to feed minature lamps for medical or dental purposes, in which case their weight is not a serious difficulty in view of the importance of the work and the small amount of energy required. Small batteries are also employed for theatrical lighting effects in which the lamps and batteries are carried by the performers when it is not convenient to supply lamps by a wire connection.

2. *Accumulators for preventing fluctuations,* due to unsteadiness in the driving power, are often applied successfully. A dynamo driven by a gas engine, for example, may vary periodically in speed because of the explosive action of the gas in the cylinder, and a battery connected in parallel with the dynamo will have the effect of steadying the voltage. But improvements in design and construction tend to reduce unsteadiness of speed, and by the use of a heavy fly-wheel, and an elastic connection between the engine and dynamo, the result is sufficiently satisfactory in most cases to make a battery unnecessary. An

*Paper by Dr. Francis B. Crocker, read before the American Institute of Electrical Engineers at its 101st meeting.

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accumulator is generally installed in connection with a small gas engine lighting plant, to enable the engine to be stopped for a considerable portion of the time and thus save labor and attention, in which case the battery may also act to prevent fluctuations, but its principle function is the former one which will be considered next.

A windmill electric lighting plant absolutely requires an accumulator or some other means of storing energy not only to eliminate fluctuations in speed which are constantly occurring, but also to bridge over the considerable periods of calm weather.

3. *Accumulators to enable machinery to be stopped* during certain portions of the day or night: The advantage of this application depends upon the fact that in almost every electric lighting plant there are long periods during the day and late at night when the number of lamps lighted is so small that it may not pay to run the generating machinery.

This plan also allows the machines to rest and cool down which greatly facilitates cleaning and repair. In a hotel, residence, or on board of a yacht it may also be very desirable to stop the machinery and avoid the vibration and noise during the night. On the other hand, the addition of an accumulator to an electric plant renders the latter heterogeneous, since the battery and its management differ so radically from the machinery and the handling of the same. It must also be remembered that the total investment is increased by the cost of the battery and its accommodation, because the generating plant is perfectly able to carry the load put upon the battery, since by hypothesis, this load is a light one. Hence the machinery might be run all the time, in which case the battery would be entirely unnecessary and sufficient rest for the machinery could be secured by using different machines for the periods of light load on successive days. These statements are based upon the supposition that the battery is not used to help the dynamos at the time of maximum load, since this case will now be considered separately.

4. *Accumulators to aid in carrying the maximum load.*—If accumulators are substituted for a certain portion of the dynamo capacity, the question arises whether the substitution secures any advantage. In regard to first cost, authorities differ widely. These discrepancies probably arise from the confusion between K. W., and K. W. hour of output. Most accumulators have a normal time of discharge of about 10 hours, hence the cost per K. W. hour is only one-tenth of the cost per K. W. of output, and this would, of course, vary with any change in the time of discharge. In many cases it is specious and leads to mistakes, to speak of K. W. hours, to appreciate which fact we have only to realize that the K. W. hour capacity of a dynamo is almost infinite, since it might run for twenty years. The actual K. W. of output, or in short, how many lamps can be simultaneously fed, is the question in electric lighting. Moreover, in most cases, the time of discharge of an accumulator is unnecessarily long, and this is particularly true when it is used to help carry the heavy load which usually lasts only one or two hours. In this case the remaining hours of available discharge are of little or no use. If it be attempted to discharge more rapidly, both the capacity and efficiency are reduced, and in many types the condition and very life of the battery are injuriously affected by a high rate of discharge. What is needed for the maximum load or "peak of the load diagram" is an accumulator with a normal time of discharge of two or three hours and having a correspondingly smaller first cost, bulk and weight, that is, about one-quarter of those of the ordinary forms of battery, but certain types of cell are capable of discharging at this rate. It is evident that the time of charging need not be made as short as that of discharging, if it happens to be more convenient to charge less rapidly.

The use of accumulators to enable the machinery to be stopped, which is a case already discussed, usually demands a time of discharge of from 10 to 14 hours, which agrees quite well with the normal discharge rate of the ordinary forms of battery, but even then the time is unnecessarily long, since the average rate of discharge would rarely exceed one-half of the maximum rate. Consequently the battery would either be incompletely discharged, or the rate would have to be made excessive at certain times.

5. *Accumulators to maintain uniform load on the engines.*—Steam engines are very inefficient at light loads. This inefficiency, in fact, is one of the chief sources of loss in an electric lighting plant, and the principal object of the engineer who designs and operates a station should be to reduce this waste to a minimum. The accumulator is the most important means of accomplishing this result, although there are other methods such as gas, thermal (hot water) and steam storage, all of which have been carefully compared by Mr. Nelson W. Perry in a paper before the National Electric Light Association, February, 1895. "Storage of Energy Essential to Economy of Working Central Stations." Judicious selection of the number and sizes of the engines would enable them to be worked at a considerable fraction of their full capacity nearly all of the time, and it would seem that the same care that would be required to manage the battery might enable this to be accompliseed. Nevertheless the accumulator gives more flexibility to the plant, and where introduced it often seems to considerably increase the economy of the engines by making their load more uniform and nearer their full capacity. According to the figures given by Mr. Perry in the paper cited above, an electrical horse power costs $48.68 per annum when developed steadily, and costs $117.78 per annum with a variable load similiar to that of an electric light station, that is, the latter costs about 2.4 times as much as the former. This ratio seems very high, but is borne out by statistics which give a very large coal consumption for most electric light stations.

Under these circumstances almost any method of making the engine loads more uniform, should increase the economy of working. Doubtless an accumulator would benefit any plant in which an engine runs for any considerable portion of the time at less than half of its full power.

If a plant is so small that it contains only one engine, it may be necessary to run it a great deal of the time far below its full load. But even with two engines it is generally possible to select the sizes so that the smaller one runs economically during the periods of light load, the larger one alone is suited to medium loads, and both are used for the maximum output, the the times during which any engine is very much underloaded being very short. With a greater number of units, it becomes still easier to properly apportion the load, and when there are five or more engines as is usually the case in large stations, the loss from this cause should be trifling. To be sure the waste of energy which occurs from using boilers for variable loads still remains, but according to the figures given by Mr. Perry this is less than that due to the engines, and general experience shows this to be true.

6. *Accumulators used as transformers.*—If the cells of a battery are arranged in series while being charged, and in parallel for discharging, a high voltage current will be required for charging and a low voltage current will be given out. The total amount of energy measured in watts is the same minus the loss of 15 or 20 per cent. which always occurs in accumulators. The result is similar to that obtained by an alternating current transformer or motor-dynamo. Such a method of transformation of potential might be employed in connection with long distance transmission of energy, the current being sent over the line at high voltage and converted to low voltage by accumulators for local distribution. For potentials of several thousand volts which are commonly employed in transmitting long distances, the number of cells required would be so great as to make this of doubtful practicability compared with the ordinary stationary or rotary transformers, but it would give uniformity in load and other advantages which may be secured by the storage of energy.

7. *Accumulators used for subdividing voltage.*—This application is similar in principle to the preceding. The most import-

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ant practical case is that in which a dynamo of 220 volts charges a battery of corresponding potential, a three wire system being supplied from the battery, the neutral wire of which is connected to the middle point of the battery. This arrangement avoids the necessity of running two dynamos, and allows the battery to be placed in a sub-station near the districts to be supplied, so that it is only necessary to run two conductors to that point instead of three. The same principle may be applied to the five-wire system.

8. *Accumulator sub-stations.*—The plan of installing battery plants at local centers which are charged from the main station, enables some of the conductors to be saved in a three or five-wire system, as already stated. It also makes it possible to reduce the size of these conductors because the current which flows over them can be kept practically constant, so that it is not necessary to have them large enough to carry the maximum current consumed by the lamps which may be several times the average value. This, of course, gives the same steady load on the generating machinery as if the battery were located near it.

The batteries at the various sub-stations may be connected and charged in series or in parallel. The former plan is similar to case 6 and would require far less copper in the conductors, since the voltage is multiplied by the number of batteries in series, and the current is the same as for a single battery. On the other hand, this high difference of potential would exist between the first and the last batteries of the series, and if either of them became grounded, any person connected to the earth and touching a wire supplied by the other battery would receive a shock due to the total voltage. This would demand that the maximum difference of potential should not exceed 500 volts, or, in other words, four batteries of 110 to 125 volts each might be charged in series and could be connected to the lamp circuits at the same time. This would practically amount to a five-wire system using accumulators to subdivide the potential as explained in case 7. If the batteries were entirely disconnected from the lamp circuits while being charged, the latter would be free from danger of the high pressure which might therefore be 1,000 or 2,000 volts if desired, the batteries being charged during the day and supplying the lamps at night. For continuous working, two batteries would be necessary. Accumulator sub-stations not only save copper in the feeders but also reduce the cost of, and lost voltage in the distributing conductors because the batteries can be placed near the lamps to be supplied with current.

Accumulators used for two or more of the above named purposes.—Each of the different uses of the storage battery has been considered separately, to avoid the confusion with which this subject is often beset, but as a matter of fact the employment of the accumulator for several of these purposes is the most common practice. By thus combining these different applications, the plant may be rendered not only more economical but also much more flexible. For example, the battery may be utilized to help out the generating machinery at times of heavy load or when the latter is partially or wholly disabled. It often happens that it is difficult to produce or maintain sufficient steam pressure owing to poor draught or other circumstances, in which event a battery enables the boilers to be temporarily relieved of some or all of the drain upon them while the pressure is being raised to the proper point. It may also be necessary or desirable to shut down the machinery or a portion of it for a few minutes to make some repair, adjustment or change of arrangement, connection, etc.

It is also possible to feed some of the circuits from the battery, while the others may be supplied at a higher or lower voltage by the machinery. In these and many other ways an accumulator may be a very convenient adjunct to an electric lighting system. The fact that it is so radically different from the machinery in its nature and action, makes it very unlikely that the entire plant will be crippled at any one time, since the two sources of current are not exposed to the same dangers. An accident to the steam piping, for instance, might shut down all of the machinery but it probably would not affect the battery, and *vice versa*.

ROCKY MOUNTAIN STREAMS.

Western Engineers are beginning to realize that the water power running to waste in the Rocky Mountains will furnish not only food for reflection, but the more material force necessary to turn the wheels of agriculture, mining and commerce on the slope to an almost unlimited extent. There is no Niagara, it is true, but an infinite number of small water courses, well located and far enough apart to be utilized throughout the length of the Pacific slope.

A practical beginning of utilizing these streams has already been made, and it will be a misfortune if Pacific coast cities fail to become competitors for these future manufactories. The mountain streams only a few miles distant can be made to furnish ample power at moderate cost. The facilities for transportation by water render those cities much more desirable places for manufacturing establishments than interior points. Immense power is sleeping in the Healdsburg canyon, good for 10,000 horse-power. There is enough water going to waste over the submerged dam near La Grange, Cal., to run 100 miles of electric railroads to near-by cities and towns. As it is now, the power of that mighty force of water is going to waste. That dam is only one of many which may be built for the purposes of irrigation, which may also be used to generate electric power for railroads. The whole western slope of the Sierra Nevada drains an almost incalculable amount of water, which is gathered, according to the water sheds, into creeks and rivers. There is the Merced river, which has fall enough to supply enough power to operate an electric road to a point on the bay of San Francisco. The same is true of the Fresno river and the San Joaquin, the King, the Tule and the Kern rivers. All those are great rivers with capacity of generating great power, which may be used for electric roads or for manufacturing plants. California cannot be too prompt to make commercial use of the power in her streams to provide it with electricity. The first great experiment—on the American river at Folsom—is successful. A hundred other schemes for putting traces and collars upon the moving waters are in the air. From Lake, from San Diego, from Kern, from Calveras, come reports of projects to make the waters do the hard work for man. Use of water for power for the electric road to be built to the Yosemite Valley is entirely within possibility, and the visitor to the wonderland may ride swiftly by the force of the very waterfalls that enchant his vision at the end of the trip.

CONDUIT TROLLEY PATENTS.

The electrical traction monopolies are stubbornly fighting every improvement, but the army of inventors will soon be too much for opposition. A patent for an underground trolley was issued July 9th of the present year to Leedham Binns, of Philadelphia. July 29th, of this year, a patent was issued for an underground trolley system to N. B. Ginochio, of New York, and Henry C. Bridger, of Woodbridge, N. J., application having been on file from December 27, 1894. August 6, 1895, a patent for an underground system was issued to J. T. & W. B. Thomas, of Catasauqua, Pa. August 13, 1895, a patent was issued for a conduit for electric conductors to F. L. Capps, of Newark, N. J. On the same day a patent for a trolley for underground electric railways was issued to M. D. Law, of Washington, and another for the same purpose to L. H. Sherwood, of Mount Vernon, N. Y. August 27, 1895, a patent for an underground electric railway was issued to D. F. Graham, of Springfield, Ohio, and W. P. Allen, of Chicago, and another for the same purpose to Emma E. Moore, of Chicago. The same date a patent for a conduit electric railway was issued to Charles H. Johnson, of San Jose, Cal. September 17, of the present year a patent for a closed conduit electric railway was issued to John M. Deal, of Lansdown, Pa. In addition to these a patent for like purposes has been issued to Petersen, of Milwaukee, still more recently.—*Engineering Mechanics.*

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ALL WELL KNOWN MEN.

New Adams-Bagnall Electric Company Made Up of Men Who Have Made Their Mark.

The new Adams-Bagnall Electric Company, lately organized at Cleveland, has announced its readiness to supply to the market a new Arc lamp. Owing to its composition in men, much interest has attached to this company from the very first announcement of its formation, and that interest increases since its actual entry into the competition field for business.

The personnel of the experts "got together" in this combination, was sufficient to bring to them a financial backing that makes the company a very strong one. Messrs Hickox, Howe and Corning are all well known men of wealth in Cleveland, and all of them acute and successful business men in their various directions.

Mr. Thomas E. Adams, who heads the firm name is one of the best known electrical inventors of the country, whose special prominence came about through the Brush-Adams arc lamp. For many years, Mr. Adams was connected with the Brush Electric Company and co-inventor with Mr. Brush. His specialty is arc lamps. There will probably never be an arc lamp that will satisfy him, and if some heaven born genius were to invent one that the whole world was ready to applaud as *perfect*, Mr. Adams would, in all human probability, be able to pick flaws in it and, ten chances to one, improve it. Unlike most inventors, Mr. Adams is a crank on economy, and can find no virtue in a piece of mechanism that is not *commercial*. His friends say Mr. Adams is an even tempered and withal patient man—ordinarily. But when things go awry, he has been known to seek the seclusion of his closet for—well say prayer.

THOMAS E. ADAMS.

Mr. E. J. Bagnall is another diverted Brush light. He has been engaged with the Brush Company, especially in the building and installation of railway machinery, although he has had much practice in central station work. He began at the bottom of the Brush ladder and had got pretty near the top, when it occurred to him that he might just as well be climbing his own ladder, hence his new connection. Mr. Bagnall is a hard worker, shrewd and practical, with an eye always to the main chance of the better sort. He and Mr. Adams are well poised and perfectly balanced running mates.

E. J. BAGNALL.

The general manager—and advance agent, so to speak, of the new company, is Mr. L. H. Rogers. If there is a man in this country who can turn more tricks to make the world look at something he has to sell, there is a large fortune lying around loose waiting for the gentleman. There was such a man once, but he is dead. When Adams and Bagnall went into the work shop to invent a new arc lamp and to perfect other things electrical, L. H. Rogers got up on the roof, and kept one eye at a crack in the shingles. When the trick was done inside, and the inventors came out to announce their success, they found that Rogers had already told it all over the country, while they were walking down stairs. Mr. Adams was so surprised to find that the newspapers and the people knew that he had a new lamp that he had to actually go back again and take a second look to see if he really had it—and he had. As assistant general manager of the Brush Company, and general manager of the Sperry Electric Railway Company, Mr. Rogers got his business education, large acquaintance and general high pressure proclivities. He had also some valuable lessons in heading off the other fellow from general manager, S. M. Hamill, of the Brush Company—he of the "get there stroke." If any business gets away from our suave and smooth friend Rogers, it will be when he is out of town.

L. H. ROGERS.

Mr. C. W. Phipps is another limb from the same Brush. He has borne the Brush pennant into remote places, both Oriental and Occidental. In the early days of the arc light, Mr. Phipps was sent to Europe to cause the light of civilization to shine in that benighted land, and later he took light into the darkness of Japan. The light was still there and evidently kept trimmed and burning at the time of the late unpleasantness with her bias-eyed neighbors. Mr. Phipps was also for a long time Superintendent of the Brush Works and had charge of large numbers of men. That he knew how to get the most work out of them under the best conditions is evidenced by the fact that he has entire charge of that part of the business in the new company.

C. W. PHIPPS.

Mr. S. E. Cox, Secy. of the Adams Bagnall Co., held an important post with the Brush Co., for a number of years in their incandescent department. His idea for some years has been that a better as well as a better looking incandescent lamp could be made. The result of this idea can be seen by looking at one of the A. B. Incandescent lamps, now being manufactured by the new company. He is the patentee of the new lamp and gives the incandescent department of the new company his particular attention.

S. E. COX.

About the only department we have not provided with a head in the new company is that department that must have a head before anything can be done anywhere else, namely the drafting and designing department. This position is filled by Mr. George Arnold, and it is filled full. Mr. Arnold is another tree from the forest, and grew like the acorn, little by little, until he was among the tall timber. He served in several capacities with the Brush people, especially in the drafting department, where his specialty was dynamic engineering.

Without further comment than a recasting of an eye over the names of the men who furnish the expert equipment for this company of gentlemen, it may be fairly predicted that things in some directions will be lively pretty soon.

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THE UNDERGROUND TROLLEY.

M. Lavezzari in an interesting paper read before the French Society of Civil Engineers and reported in l'Industrie Electrique, reviewed the question of the applicability of the underground trolley to electric railways. An electric railway, says M. Lavezzari should fulfil three principal conditions: First, safety of the public: second, sightliness; third, economy. The storage system fulfils the first two of these conditions, but not the third. The weight of the car is also greatly increased. The overhead trolley fulfils the first and third conditions, but it is unsightly and should not be permitted to disfigure the beautiful avenues of great cities. The first condition is not satisfactorily carried out, inasmuch as communications with the ground are so readily made. By elimination, therefore, we arrive at the conclusion that the underground trolley is in certain cases the system to be adopted.

Two lines of electric railway with underground trolley are already in operation in Europe; the older one is that on the Esplanade at Blackpool, England, where the Holroyd Smith system is employed, and the other at Buda-Pest where the Siemens-Halske system is used. The latter railway is the more important on account of its extent.

Many trials were made before the system to be employed at Blackpool was decided upon. The line presented very unfavorable conditions, as it extended the entire length of the Esplanade, where it was exposed to the violent gales of the Irish Sea, so that the conduit was often filled in winter with snow, and at all times of storm with sea water. Notwithstanding these obstacles the results of the operation of the line have been very satisfactory. The trolley current is conveyed by a rigid circular cable through a flexible conductor to the motor; the return current is carried by the rails.

The conduit through which the conductor passes is placed between the rails and parallel with them. Small openings with removable covers are placed short distances apart to afford opportunity for cleaning the conduit. Water which enters the conduits is collected in small sumps and is hence returned to the sea by means of drains.

In order to show the variations in receipts and expenses of this line in the summer or busy season and the winter or dull season in Blackpool, M. Lavezzari gives the following statistics: During the winter the receipts amounted to $64.40; the expenditures to $138.02. In the summer, however, the receipts rose to $1,970.24, while the expenditures were only $185.41.

The electric railways of Buda-Pest present a striking analogy to that of Blackpool, but the conduits contain two conductors, one for the trolley, the other for the return current. The rails are not used as conductors at all. The conduit is located under one of the rails, so that the roadbed presents the same appearance as the ordinary street railway track. This disposition has also the advantage of doing away with the third rail. Cleaning the conduit is accomplished in practically the same manner as in Blackpool.

The following statistics show the receipts and expenditures of the Buda-Pest railways during 1894: Receipts, $588,800; expenditures, $308,200 out of which about $23,000 is charged against maintenance and inspection.

M. Lavezzari also describes a projected electric railway in Paris for which a concession has already been granted. The electrical equipment is to be the Holroyd Smith system, but will differ materially from that in operation at Blackpool. The feeders will be inclosed in a conduit located between the tracks, large enough to permit the passage of men. The trolleys are placed under one rail of each track and are accessible from the conduit, which will allow constant cleaning without disturbance of traffic in the street above. No current passes through the rails, both the trolley and return currents pass through the conductors; these are reinforced at certain distances by feeders, so that by means of switches a portion of the line can be isolated for urgent work in case of need. Notwithstanding the increased expense occasioned by the construction of the conduit, M. Lavezzari thinks that the system may prove to be the most perfect in operation, and that the saving in the cost of maintenance and operation will more than compensate for the increase in expense.

ANACONDA COPPER MINE.

Facts About the Output and Profits Derived From This One Property.

The ascertained cost for the production of refined copper delivered to the buyers will seem astonishing, says the Engineering and Mining Journal; but it must be borne in mind that every one of the thousands of tons of ore handled contains from four to six ounces of silver, and some of it a small amount of gold, Taking one month, for instance, of this year and that no exceptional one as to tonnage there were as a daily average, 2,800 tons of ore concentrated, and between 250 and 300 tons of picked ore smelted without concentration, containing in round figures 9,000,000 pounds of copper in that month, and for the first six months of the current year, on a copper production of less than 50,000,000 pounds, there was a net profit of nearly 4 cents a pound. From the balance sheet for the first half of the present year it will be seen that the net profit was $1,931,307.

There has been much curiosity to know exactly what the Anaconda ore does run, and we are now in a position to state that the average during that half-year was over 6.75 per cent. copper; that the average silver is about 4.5 ounces to the ton of ore, and that the gold collected in the six months amounted to about 12,000 ounces fine.

The past history of the mine is just as interesting as its present condition. The Anaconda proper, with which is worked as one mine the St. Lawrence, has been in operation about 15 years. The workings now extend more than 2,200 feet in length upon the vein, and to a depth of 1,300 feet; the ore is variable in quality, and in the early days before the reduction works were established at Anaconda, about 37,000 tons were shipped to Europe, containing on an average 45 per cent. copper, and 20 ounces of silver to the ton. Throughout the length of these workings, the vein is practically continuous, 10 to 15 feet in width in the narrowest portions, and over 100 feet in the widest, and may be fairly stated to average between 30 and 40 feet. In 1884 treatment of the ore was commenced at Anaconda. and in smelting an enormous tonnage between that date and 1889, the contents of the ore was about 8 per cent. copper; but as this was all sold or sent to refiners in the shape of matte, there was little or no profit from the silver—a very different condition of affairs to the position the company is now in, being now probably the largest silver producing property in the world. During the past four years, the average grade of copper in the ore has been exactly 76.6 per cent. From the opening of the mine to October 1st, 1895, more than 3,000,000 tons of ore, valued between $50,000,000 and $60,000,000, were extracted from the Anaconda and the other properties belonging to the company. In the Anaconda and St. Lawrence mines, according to the reports of the experts, there are 1,750,000 tons in sight, which would contain, based on the average contents during the first six months of this year, 163,800,000 pounds of copper, and 5,687,500 ounces of silver and about 29,500 ounces of gold. The outside properties have produced up to the same date about 2,500,000 tons of ore, and have now in sight at least 1,250,000 tons, and on their average contents for the first six months of this year this would add to the reserve 132,000,000 pounds of copper, 8,925,000 ounces of silver and 46,200 ounces of gold.

This is the first opportunity that has ever been given to thoroughly realize the magnitude of this, the largest copper property in the world. The only mines to compete with it in resources and in present output of copper are the Rio Tinto in Spain, which comes second, and the Calumet & Hecla, Lake Superior, which is third.

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THE ALTERNATING CURRENT.

Readily Available to Physicians for Therapeutical Purposes Because of its Very Extended Use in Incandescent Lighting.

VALUABLE IN TREATMENT OF RHEUMATISM.

For four years I have been making therapeutic use of the Thomson-Houston alternating current. It is the current that lights the incandescent lamps in a very large proportion of the towns and cities of the United States and Canada. It is quite universally distributed, and I am informed within the last week, by one of the electrical experts of the General Electric Co., that there has been about ten per cent. of stations added to the number since the last report was issued. It is employed in many small towns and in all the large cities. A great many physicians therefore have access to it, and many of them already have their offices lighted by this system. I have had my own so lighted, for four years.

On the street mains, the electro-motive force of this current is usually about 1,500 volts, but by means of transformers it enters the buildings at a pressure of 50 or 100 volts. You can get either pressure for the lighting of offices or houses. That which I have utilized has been through the transformer which gives me a current at a potential of about 50 volts. The periods of alternation are about 124 per second; so you see that we have a current here that is alternating at a considerable rapidity. The alterations are uniform and the current steady. If, therefore, this current is of any therapeutical value, it is only necessary to have some convenient means of modifying it. This I have been able to do in a most satisfactory manner by using the McIntosh Controller. It is a very simple matter to modify the current. I have preferred the McIntosh instrument, because by means of it the current can be increased or diminished on the decimal system by tenths and hundredths. The current can be adapted in that way to any patient in whose case it is indicated.

There has been a great deal written in the last few months concerning the physiological and therapeutic influence of alternating currents. An alternating current has not many of the properties possessed by the continuous, or direct or galvanic current. It will not electrolize, at least not to any considerable degree. I find the current does electrolize to a slight degree, but you cannot use it for electrolysis as you can a galvanic current. It will not produce cataphoresis because of its alternations. It will not carry substances in solution in but one direction, because there is no polarity to it, or the polarity is constantly changing. But there are certain therapeutic effects you get from it, very similar to those you get from the secondary induction coil current, particularly from one made of fine wire with many turns. Even from this it differs however, because the alternating current derived from a dynamo is very nearly sinusoidal, or raggedly so. What I mean by that is, that it is not smoothly and equably carried up in its positive potential, and then decreased to zero with a corresponding but reversed gradation, and then the negative potential passing through a like curve. It does not have the smoothness of an exact sinusoidal current such as you get on the Kennelly, or on the McIntosh alternator. A dynamo could however be so constructed as to give a perfect sinusoidal current. The beneficial effects I have found following the use of this current can, I think, be attributed largely to its influence on muscular structure.

Muscular tissue makes up a very large part of the structure of the body. There is not an organ whose function is not directly dependent upon it. It is plain to be seen, therefore, that an agent which is able to act upon it beneficially, has a broad field of usefulness. In stimulating and so keeping up the nutrition of the voluntary muscles when this nutrition is either directly or indirectly impaired, this form of alternating current has proved very useful. Like the true sinusoidal current it vigorously but pleasantly arouses muscular action with but little disturbance of the sensory nerves. There is no disagreeable effect with it, if the current is not too strong. By means of one of the controllers before mentioned, the current can be made as gentle as need be, and can be increased without its becoming intolerable. Involuntary muscle as it exists throughout the entire circulatory system, from the heart to the terminal arteries, the muscular structure in the blood vessels which entere into the liver or the spleen, or into the kidneys, the intestines or any other organ, can be brought under the control of this muscular massage. This alternating current has sufficient slowness in periods to affect the nerves which control this muscular structure, and this both directly and indirectly produces a toning effect upon the blood vessels. This was shown in a most convincing manner by one case I had under treatment. This patient was suffering from occasional vaso-motor paresis of the terminal blood vessels, with effects resembling purpura hemorrhagica. Hemorrhages took place over various parts of the body and occasionally over the face; great prostration, with mental weakness and confusion accompanied the attack. I tried various forms of treatment with indifferent results, until I made use of the alternating current from this particular form of dynamo, and I found that it was not only agreeable to the patient, but controlled that vascular feebleness and quickly toned up the arterial system. This action may have been upon the nervous structure rather than upon the muscular structure, but it will act upon the voluntary and the involuntary muscle tissue as well. Then there is an influence exerted by it upon the nutritive processes. This may be secondary to muscular stimulation, but it seems to be very decided.

A paper of much value was read by Dr. Jewett, of Dayton, Ohio, upon the treatment of arthritis deformans by the direct or galvanic current. This is one of the most perplexing disorders that the physician has to deal with; one in which the nutrition is so continuously changed as to result in deposits in and about the small joints of the extremities. Oftentimes remedies have no affect in modifying the morbid nutrition, and the disorder goes on causing distortion of the joints, until the limb is rendered useless by reason of the deformity which the disease produces. It is generally agreed that this is a very intractable disease, and it is admitted there is no medicinal treatment for it which seems to be of much service. I have had some cases of chronic rheumatism and of rheumatic arthritis of this character which I have subjected to treatment by means of this form of alternating current. I have had a large flat porcelain dish made, and the diseased extremities are placed in this and surrounded with a one per cent solution of salt water. One electrode is placed in this bath and the other is put in contact with the hands, spine, or breast bone. This current is then passed through the body for fifteen or twenty minutes daily. Some patients have been treated without benefit by other forms of electricity before this treatment was used. This treatment, after it has been given for about three weeks, often results in entire relief from pain. Some patients who have been unable to walk and who could not even stand on their feet, have left me after six weeks entirely relieved of the disorder, while others have been so comfortable that they could walk two or three miles without experiencing any pain. A subsidence of the inflammation and a decrease in the size of the diseased joints, together with increased mobility, usually attends the relief from pain.

As I have said, I have subjected chronic rheumatism also to the influence of this current with happy results. How the current produces this effect upon the nutritive processes, I am yet unable to explain. I do not know whether it is possible to do so. It may be, by toning up the terminal blood vessels and thus promoting absorption, or it may be that the to and fro vibratory action tends to break down that morbid chemical union that has taken place, and so favors normal physiological action. It is true that the molecules must get a vigorous shaking up by this procedure, and if the pathological products are unstable, they are probably so disturbed that through the reasserting of normal functional activity the system is relieved of them. I am not

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prepared to give you a very long list of cases that have been treated in this way, but I have had enough to permit me me to speak positively of its effects, and to point out along what lines this particular form of current seems to have been most serviceable in my hands. It is, like a sinusoidal current, more marked in its effects on the muscular tissue, but it also has a nutritive influence, and will bring about nutritive changes if its application is persisted in. The fact that this form of current is becoming so universal as a means of lighting, is turning the attention of electricians more and more to it. It can be transferred to greater distances more economically than the constant current, and it is going to be even more generally accessible to physicians throughout the country than it now is. Many already have it within their reach, and if one can have "on tap" an energy which promises to be of so much service therapeutically, and at the same time is useful in the physician's office in many other ways, it is something that he cannot well afford to do without.

ELECTRIC BICYCLE.

At a recent meeting of the Societé Internationale des Electriciens of Paris, M. Arnoux described the new Pingault Electric pacemaker bicycle. The bicycle, which was constructed by M. G. Richard, has been designed with the view of improving the pacemaking on track runs where the pacemakers have to be changed every few laps, with the result that the pace is altered at every change. Riding the Pingault cycle, one man can make the pace for an hour at a stretch at speeds up to or beyond 50 kilometers (31 miles) an hour. The machine is driven by the rider in the usual way by pedals and chain, but an auxiliary source of power is provided by two electric motors behind the saddle. These motors are both mounted on the same shaft, and drive a wooden wheel acting directly on the pneumatic tire, an arrangement which obviously permits of an exceedingly great angular velocity in the motors. The current is derived from accumulators carried in a box mounted in the frame between the rider's legs—apparently very much in the same manner as a travelling-bag. The accumulators are split up into four batteries, any or all of which can be switched on according to the speed desired. The switch is on the handle bar, but no details of the accumulators are given, though it is stated that they give 25 watts per kilogramme (11.3 watts per pound). The total weight of the machine, including the accumulators, motors, and fittings, is 90 kilogrammes (about 200 lbs.), but this has been somewhat reduced in a later design. As L'Industrie Electrique (December 10) remarks, the practical application of the accumulators used by M. Pingault will be awaited with impatience if they can maintain the efficiency above stated.

NEW ATLANTIC CABLE.

The French Budget Committee has just approved the terms of a contract between the Government and a French Cable Company, for the laying of a cable across the Atlantic between Brest and New York, with an extension to the West Indies, and thence to Para, in Brazil. The committee declined to sanction M. de Mahy's proposal for a cable between Rèunion and Mauritius, their view being that all such schemes should be initiated by the Government. The *Debats* comments on the tenacity shown Great Britain, despite Brazilian protests, in regard to the possession of the Island of Trinidad, "which will be for her South Atlantic cables what Bermuda is for the North Atlantic ones," and it adds that Mr. Chamberlain is showing an active interest in the scheme for a cable between British America and Australasia, "which will crown the practical cable monopoly possessed by England."

Send in your subscription to THE ELECTRICAL JOURNAL.

RETAILING ELECTRICITY.

Electric energy is now peddled in New York just like milk, says the Journal.

A wagon starts out at an early hour every morning for the purpose of collecting empty cans. Electricity cannot, of course, be dipped up and poured into the cans with a ladle. The method is far more complex, and takes a long time. A hundred cans are connected with a dynamo in the electric dairy and the current is turned on. It takes about ten hours to fill the largest cans, which are usually allowed to remain connected with the source of supply for an hour or so longer, in order to give good measure.

The electric supply man makes life easy in a hundred different ways. The batteries are used to run fans in sick rooms, for instance. One of the most novel uses, of the current, however, is to hitch up the electric batteries to play the piano or to work the pedals of an organ. Hotels are good customers, since they obtain motive power for their coffee mills and grindstones in this way. Theaters are steady patrons. The energy they buy is used mostly for supplying the small electric lights carried by ballet girls. In such cases the battery must, of course, be carried by the performer, and it is therefore very small and of such a shape that it will not attract the least attention.

The electric supply man stops very often to dispense small pocket batteries to be worn by bicycle riders. These small cans, if well filled, will light a bicycle lamp for ten hours.

A stranger to the business rode over one of the longest of the electric can routes one morning last week on the battery supply wagon. The wagon started out with about five-horse-power of electrical energy stowed away in the cans. The latter varied in size from the pocket battery, about the size of a box of cigarettes, to a heavy battery six feet long, which it took two men to lift into the wagon.

STRIKES FINANCIAL BREAKERS.

The litigation over the possession of the electric light plant in Fond Du Lac, Wis., took an unexpected turn a few days ago. Elihu Colman, who came into possession of the property under a disputed claim of ownership and who has had personal management of the plant for three months, asserts in an affidavit that owing to heavy outlays for machinery, repairs, and other expenses, he will be unable to continue its operation unless the court orders that about $10,000, claimed to have been expended, shall be a first lien on the property. Nearly everything that the present manager has purchased is under chattel mortgage. The finances of the concern are not in a flourishing condition nor have they been since the litigation started. The First National Bank of Chicago, H. F. Whitcomb, of the Wisconsin Central Road; W. G. Decelle, the original owner, and Mr. Colman, who is a local attorney, are parties in the litigation.

NAME FOR MOTOR VEHICLE.

The London *Times* has gone into the hunt for a name for the motor vehicle, and after a long search comes back with the word "auto-car." The Electrical Engineer (London) in commenting on the name says: "As for ourselves, being linguistic purists, we do not care for hybrid constructions—"auto" is Greek, while "car" is Latin and Celtic. At the same time, such clumsy phrases as "horseless carriages," "mechanical road carriages," and "self-propelled vehicles" are not meeting with general favor. Why not therefore adopt the philogically sound "motor-car," which could be run into a single word, "motorcar?"

HARNESSING THE TIDES.

Probably the first attempt to make practical use of the great energy of the tides is now being made on the Pacific Coast at Santa Crux. A dynamo, to cost about $20,000, is now being placed in position. It will be worked by a head of water raised by the tide, and the electrical energy thus obtained will be employed in lighting the town and driving the street cars. That, at any rate, is the idea, although whether it can be successfully carried out remains to be seen. The apparatus will be completed, and, it is expected, in full operation, early next month.

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

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Brooklyn Bridge and Electricity.

The objections of Mr. C. C. Martin, Chief Engineer of the Brooklyn Bridge, to replacing the inadequate cable service of the Bridge Railway with electricity are not well taken. The whole of Mr. Martin's contention lies in the statement that the cable goes a certain constant speed; that the distance between trains is regulated by a starter, and that each grip grasps firmly the rope and maintains its hold until it gets across, thus making it impossible for a collision to occur. He states that 392,000,000 of people have been carried with only one accident. He takes it for granted that electricity could haul only the motor car; and he assumes that if electricity were used the cars would cavort about over the bridge like a lot of unbridled colts, colliding with each other and playing havoc generally.

The trouble with Mr. Martin's position is that he isn't posted. Barring details, which cut no figure, the proposed electrical service for the bridge would not differ from the service supplied by the Intramural road at the World's Fair. That road carried about 6,000,000 of people, mostly within three months. Its grades were bad, the curves were many and sharp, trains were heavy and frequent, stops were also frequent, badly graded and on curves; obstructions to the view were many and annoying, and last but not least, the road was an experiment of the crudest sort, and the elevated structure was temporary and in some respects faulty. Yet there was only one accident during the whole existence of the road and that wholly independent of it. The trains were made up of the motor car and from two to eight coaches. Naturally the speed, stops and starts were independent for each train, and all the bugaboos which Mr. Martin conjures up were present on the Intramural. An elaboration of that same system is in operation on the Metropolitan Elevated road in Chicago at the present time. There is no reason, scientific, practical, sentimental or economic, why a similar system, adapted to the special requirements of the Brooklyn Bridge cannot be provided.

The plan which would suggest itself to a purely disinterested observer would be to transform the bridge into what we usually term a loop service. Allow all the Brooklyn roads to use the bridge on equal terms by some such plan as that employed on the St. Louis Bridge and Tunnel road—that is each freight car wheel is taxed so much—or each road is taxed so much per passenger carried. The Bridge would furnish all power, feeders, road bed, police service, etc., and allow each road to accommodate its patrons by running either single motor cars or trains.

We have no doubt that such a service as this would be efficient and satisfactory. It would certainly please the Brooklyn people by making a transfer unnecessary, and last, but not least, we can assure Mr. Martin that the Bridge can turn many an honest penny if the plan is properly manipulated.

* * *

Taxing Street Cars.

The Toledo Blade furnishes the following lucid and logical (?) argument on the subject of taxing street cars:

"In looking about for ways to secure more money for Toledo's treasury, there is talk among certain councilmen of amending the wheel tax to include street cars. In many cities every street car is taxed, and a large amount of money is raised in this way, the belief being quite general that street car companies do not pay the city any too much for their valuable franchises.

It is a question, however, if the people be as greatly benefited by levying a tax of this kind as they would be in reducing the price of fares. The trouble is that in taxing the cars, the companies will run as few of them as possible; and the public can expect crowded cars, especially mornings, evenings and stormy days. Here in Toledo, for instance, on a rainy day the managers of the street car lines know more people will ride than if the day is bright and pleasant. To meet this extra demand, they call out extra cars. This they would not do if a tax were levied on each car. By reducing the fare the general public would be benefited and the men and women who can least afford to ride and yet are compelled to use the cars in going to and coming from their work would be the greatest beneficiaries. Just now the question of reduced fares is being discussed in many cities, and the feeling is that the days of five cent fares are nearly ended.

The majority of the people of Toledo, would rather see a reduction in fares than to see a tax placed on street cars."

It may be that we are dull of comprehension, but if the primary object is to raise more money for Toledo's treasury as stated, in what way, may we ask, will the reduction of fares contribute to that end? Again: If the railway companies recognize as the Blade says they do, that more people ride on rainy days than on fine, and the same principle will apply to Sundays, holidays and special occasions, is it reasonable to assume that the companies will allow the increased revenue on such occasions to slip through their fingers simply because by putting on extra cars they would render these few cars liable to the tax whatever it might be? The line of argument will not bear close scrutiny. The only conceivable condition where such a policy would be tenable would be where the tax was equal to the net earnings of the extra cars and if Toledo in its financial stress should seek to impose any such unreasonable tax as that, then the company would be quite justified in its refusal to furnish the service. The policy of the ELECTRICAL JOURNAL has been clearly defined in the matter of reducing the fare below five cents. We have said before and we repeat it again that the public is willing to pay five cents for a high grade service and that any effort put forth should be directed towards obtaining the very best service that can be had for five cents (and there is room for improvement) rather than toward cutting the fare to meet present conditions.

* * *

The Patent Question Again.

Technical journals all over this country and in Europe are reprinting, with editorial comment, Mr. Edison's recent alleged utterances against the American Patent Office and the patent system of this country generally. We do not know positively, of course, that Mr. Edison made use of the rather sensational language attributed to him, and the only way to find out would be to ask him, as Mr. Edison is too busy a man to run down all the silly things he is made to say by our friends of the lay press. If Mr. Edison uttered the tirade against the Patent Office charged against him it was rank ingratitude, because he has fared better than almost any other inventor as a result of his patents. But this fact does not upset the truth of most of the

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things stated in the interview—an epitome of which would be the bare statement that the whole patent system of this country is a farce, its officers incompetent or worse, and the weight of an American patent being simply a standing in court. This is a broad assertion, but some of it is true, and it will not be the less true until the inventors and manufacturers get together and demand of congress a radical change.

THE ELECTRICAL JOURNAL has taken occasion to discuss this matter before. It pointed out at that time that Congress—at least its moss-back contingent—was largely to blame for failure to make intelligent reforms and proper appropriations. The chief of reforms should be the separation of the Patent Office from the Interior Department—the head of which is always a political creature—and who just at the prèsent time is abusing his office by making the department a campaign adjunct to his candidacy for the United States Senate.

There are now in the neighborhood of two millions of dollars lying in the treasury, the direct earnings of the Patent Office, but unappropriated and unavailable. This while so small salaries are being paid that experts cannot be had who will remain there after they have become really of value. They are invariably lured away by better salaries and their places taken by incompetents who go through the same schooling only to follow their predecessors. And so the merry round continues, always to the disgrace of the department and the country.

A few things are wanted for the commencement of the reform, among them these:

Separation from every political dependence, civil service throughout, good salaries, and a law providing that the government shall guarantee the integrity of every patent it issues.

* * *

The Storage Battery.

The Storage Battery discussions recently held under the auspices of The American Institute of Electrical Engineers have been productive of much good, if for no other reason than that they have demonstrated that the storage battery has got beyond the question of manufacture and is now to be treated wholly from the standpoint of utility. In his paper on the subject, Mr. C. L. Edgar defines the status of the storage battery most clearly, as we view it. He says: "It is a source of great satisfaction that the storage battery discussion has, within the past few months, especially in America, taken on an entirely new phase. It has become a question of use, and not of manufacture. * * * * We have discussed their value, at first confining ourselves as to whether they would work at all, and in later years broadening out the discussion as to how well they would work. We have watched the various companies interested in the manufacture of storage batteries, fight one another in the courts, and we have wondered if it were ever to be possible to obtain a battery which did not infringe some one else's patent. * * * * Whatever may be the facts as to the existence of a commercial battery, some of us have purchased and are operating batteries which we consider satisfactory."

We do not know how to give more clearly or completely, a history of the storage battery. Volumes would not tell better the trials of litigation, the experiments, partial success, and finally all the rest is summed up in that brief expression "batteries which we consider satisfactory." The discussion is a live one, and interesting. We believe our readers will appreciate the papers by Mr. Edgar and Prof. Crocker, presented in other pages of this issue.

* * *

For Pure Water.

Baron Tyndal, a Hollander, who has been experimenting for ten years, has at last arrived at a method for the perfect sterilizing of drinking water, by simply forcing a current of electrified air through it. The Baron "first catches his water," then places it in a glass receptacle. The next *important* step is to pass through it a volume of air electrified by a current varying in voltage from 10,000 to 30,000. It is needless to add that all organic matter, fish, flesh, and fowl, is dead after this procedure and one simply drinks soup. If a Pasteur filter is used, it is consommé.

The question is: Has Baron Tyndal served humanity by his new device? Water, especially in Europe and Kentucky, is not considered strong drink at best, and if now it is to be deprived of its "body," it becomes a hollow mockery, unless—and there seems to be a straw worth grasping at—some of that current of electrified air remains. Would not such a drink be champagne? If it is we shall bear with the Baron. Else give us our water at as nearly first hand as possible, germs, bacilli, inorganic compounds and all. Only let us have *life* even in the water we drink!

* * *

Errors and Things.

We were not deceiving ourselves in assuming that our distinguished contemporary in blue was a careful and interested reader of THE ELECTRICAL JOURNAL. But we had hardly dared hope that he was so assiduous and persistent in his perusal of its columns that the first typographical or proof reader's error would catch his eye. And further, even if we had suspected his watchfulness in this regard, we would still not have flattered ourselves that so small a thing as he spends half a column upon editorially in his last issue would seem so great an error to him. Undoubtedly his attentive reading of THE ELECTRICAL JOURNAL since its existence has educated him up to high ideals in points of accuracy and literary merit. We congratulate ourselves that it has taken our severest censor seven long months to find one tiny little slip.

* * *

The Rockefeller Propaganda.

President Harper and the University of Chicago seem to have all they can do keeping step with Mr. John D. Rockefeller's financial views. Last summer it was Prof. Bemis who had to be sacrificed for heresy. Just now Prof. Von Holst seems to be in squalls and Dr. Harper had to come to the rescue. Within three days Dr. Harper, Prof. Von Holst, Dean Judson and Prof. Small were interviewed and had signed articles in the Chicago dailies alternately. Their positions on the Venezuela imbroglio shifted with every press installment. They are to be congratulated that they finally got round to the wind they were supposed to trim for. The spectacle was hardly edifying, however, and it might be in the interest of the University to suggest that the next time it would be just as well to consult Mr. Rockefeller's financial agent before instead of after the press bureau goes to work.

* * *

Free (?) Advertising.

The Underwriters' National Electric Association which held its convention in New York recently, might have become a more pronounced advertising medium for one or two manufacturers, but not in the short time the convention lasted. When the secretary's press report was sent out the last half-dozen lines were given to a bare-faced "ad" of one of the manufacturing companies. The particular company was all right and its goods all right, but the official report of the secretary was hardly the place to say so, especially as the matter was dragged in by the ears.

* * *

To that shining aldermanic light in Chicago who proposes "a three cent fare for standing room only," we would like to present a hypothetical case: Suppose a man gives his seat to a lady after paying full fare, and when his ride is half over—would he be entitled to a rebate and if so how much? And how about the lady? The company does not give her a seat. She gets it from a man who paid for it for the trip. What does she pay?

* * *

We warned England long ago that the usurpation of electrical units by the British Association would lead to war.

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Copper, and everything connected with its output, is a mighty interesting subject to the electrical manufacturer. In another column will be found some figures upon the subject that are worth studying. Comment on these figures will perhaps be superfluous, but it may not be out of place to suggest that while margins of profit to the electrical manufacturer are small—sometimes very small, the Anaconda copper kings balanced up for the first half of the present year a net profit of $1,931,307.00, this representing a net profit of 4 cents per pound of copper.

Have we a copper trust?

The friends of George D. Burton will be pained to learn of his financial misfortunes. Mr. Burton is undoubtedly the victim of that rare form of 19th century insanity, the prominent symptom of which is a belief on the part of the afflicted that he can lift himself up by his boot straps. George Burton may be unwise in respect of money affairs, but no one will ever accuse him of any action not consonant with the most rugged integrity.

Manager Hamill, of the Brush Company, evidently admires the press bureau of the General Electric. There are all the ear marks of an attempt on his part to organize a similar institution. Brother Hamill! There is a lot of free advertising in the Brush Consolidation story. Dollar a line stuff, too! Editorial skits thrown in!

In charging "ten cents per session" against students in some of his classes at the Armour Institute, Mr. Armour seems to have got his philanthropy mixed with the price of pork. The question will naturally arise whether the Armour Institute can eventually be made as profitable as a well-ordered butcher shop.

"*As compared with Chicago, Philadelphia is paying for electric lighting* $1,300 *daily, or about* $475,000 *per year more than it should pay with a fair profit for the companies.*"

Evidence given before the Senatorial Investigating Committee in Philadelphia.

Most of the Electrical Journals are in the throes of conflict trying to prove that they are the oldest Electrical Periodical in the United States. If it will end the controversy, we will admit that several of them are old enough to know better.

We have feared all along that the trouble between Professor Forbes and his millionaires would end in dread war. This thing should have been arbitrated.

We are ready to give all the rights of way to our warring contemporaries in their race for age. We are satisfied with being best rather than oldest.

NOTE.

In our announcement in the last issue, of the decision of Judge Townsend of the United States Court sustaining the Vandepoele *under-running* trolley, a proof reader whose mind must have been on a present live discussion, made the matter read "*under-ground* trolley." The error was so manifest that a correction seems hardly called for.

AN ELECTRIC INCUBATOR.

An improved incubator has been devised and built by George H. Stahl of Quincy, Ill. The heat of the machine is regulated to the greatest nicety by a thermostat automatic in its action, to a small part of a degree.

The incubator casing has the usual double walls inclosing a filling of mineral wool, and the heat is supplied from the water tank at the top, the heating and setting up of a circulation in the water being effected through a small connected reservoir at one side. In the old style incubators the heating of the water was effected by a lamp, there being a lamp regulator controlling the flame, and a valve regulator acted upon by the heat of the water before entering the tank, while both regulators were actuated by an improved thermostat.

In the electric incubator, or "Electric Hen," as it is called, the water is heated by a resistance box, the current which can be regulated with extreme nicety. The same manufacturer is now also building an incubator with a combination heater in which oil, gas or electricity may be used.

TAKEN INTO THE FOLD.

American Institute of Electrical Engineers Increases its List of Members.

At the regular monthly meeting of the council of the American Institute of Electrical Engineers held in New York, December 18th, the following members were elected:

Chas. F. Bancroft, Electrical Engineer, Lowell and Suburban Street Rail way; residence, 60 Fort Hill Ave., Lowell, Mass.

Frank E. Herdman, Mechanical and Electrical Engineer, Crane Elevator Co., Winnetka, Ill.

Richard Lamb, Chief Engineer, The Trenton Iron Co., 1 Broadway, N. Y.; residence, 72 W. 69th St., N. Y.

Leon Le Pontois, Electrical Engineer, The Westinghouse Elec. and Mfg. Co., Pittsburgh, Pa.

Harry W. Ludlam, with Western Electric Co.; residence, 480 Lexington Ave., N. Y. City.

Samuel G. McMeen, Assistant Engineer, Central Union Telephone Co., 1306 Ashland Block, Chicago.

Frank L. Seidmore, with Western Electric Co.; residence, 480 Lexington Ave., New York City.

Joseph P. Stone, Electrical Engineer, General Electric Co.; residence, 213 Liberty St., Schenectady, N. Y.

Norman W. Storer, Electrical Engineer, Westinghouse Elec. and Mfg. Co., Pittsburgh; residence, Wilkinsburg, Pa.

Chester H. Thordarsson, Chicago Edison Co.; residence, 896 Davis St., Chicago, Ill.

Harrison C. Wybro, Electrical Engineer, Wybro & Lawrence, Los Angeles, California.

The following Associate Members were transferred to full membership, their applications having been approved by the Board of Examiners:

George Stephens, General Superintendent, Canadian General Electric Co, Peterboro, Ont.

George White-Fraser, Electrical Engineer, Toronto, Ont.

Alex Dow, Engineer, Public Lighting Commission, Detroit, Mich.

Samuel G. Neiler, Assistant Electrical Engineer, Pierce and Richardson, Chicago, Ill.

Knowles L. Perot, Vice President and General Manager, Schuylkill Valley Illuminating Co., Phœnixville, Pa.

John Balch Blood, Assistant Engineer, Railway Department, General Electric Co., Schenectady, N. Y.

Franklin Sheble, Electrical Engineer, Philadelphia, Pa.

William H. Freedman, Tutor in Electrical Engineering, School of Mines, Columbia College, N. Y. City.

Andrew L. Riker, The Riker Electric Motor Co., Brooklyn, N. Y.

John A. McCrossan, Manager and Electrician, Citizens' Telephone and Electric Co., Rat Portage, Ont.

The following committee was appointed by President Duncan to consider the question of incorporation of the Institute, and any revision of the constitution that might be necessary to comply therewith:

W. B. Vansize, Esq., Chairman; Prof. H. S. Carhart; Mr. W. F. C. Hasson; Mr. A. S. Hibbard; Dr. Cary T. Hutchinson; Mr. T. C. Martin; Mr. Townsend Wolcott.

TO AID THE FIREMEN.

Fire Commissioner Russell, of Boston, has made a practical application of a novel electric device by which communication can be had between the pipemen handling the hose in a burning building and the engineer in charge of the steamer furnishing the water supply. Several tests of the apparatus were made nearly a year ago but nothing further was done with it until a few days ago. Now steamer No. 6 has been equipped with the device and if it works satisfactorily in actual practice the whole fire brigade will be similarly equipped.

It is claimed for this device that the personal safety of the firemen and the general efficiency of the department are greatly enhanced.

The apparatus is very simple, and, it is stated, cannot be broken or disarranged by ordinary service.

Each section of hose is fitted with a complete double line of wires in the fibre of the jacket, and by an ingenious arrangement in the couplings and the pipe the electric circuits are made perfect. There is a press button set into the base of the pipe and a pressure upon it by the finger is responded to by a small steam whistle located on the engine. By means of a code of whistles, numbers being used, the nozzleman can talk to the engineer.

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NEW BOOKS.

ELECTRO-THERAPEUTICAL PRACTICE.—A Ready Reference Guide for Physicians in the Use of Electricity. By Charles S. Neiswanger, Ph. G., Professor of Electro-Physics, Post-Graduate Medical School of Chicago. Flexible leather, 80 pages interleaved. $2.00. Chicago: E. H. Colegrove & Co., 1895.

The sub-title of this little book furnishes the book's reason of being. It is emphatically a ready reference guide. The various diseases are arranged alphabetically and under each is given the appropriate electrical treatment. The author has probably the best practical knowledge of electro-therapeutics of any layman in the West and his directions are in the main beyond reproach. It might, however, be interesting to treat a case of insanity, acute mania for example, by the static head breeze followed by static endured for 25 minutes every other day—that is, it might be interesting for the operator. The author concludes by giving a synopsis of Dr. W. J. Morton's article on the uses and applications of the various electrical currents. The book will undoubtedly have a ready sale and will be of value to the busy practitioner.

THE REVUE GENERALE DES SCIENCES.

The November 15th issue of the above mentioned journal contains articles by W. Ostwald on "The Overthrow of Atomicism," by A. Larbalétrier on "The Present Condition of the Culture of Barley and Hops in France," by Dr. M. Springer on "The Progress of General Pathology," and under the department of Scientific and Industrial Facts, there is an excellent report by M. A. Gay, on the return of current in electric railway lines and the welding of rails, and on the transportation of electrical energy to great distances.

The November 30th issue of the "Revue" contains an article by Dr. E. Retterer on the "Placenta of the Carnivora," the second part of an article by G. Mouret on "Entropion, Its Extent and Variations," an annual review of agriculture by P. Dehérain, and an illustrated report by G. Charpy on the researches of Lord Rayleigh and Professor Ramsey on the preparation of argon and analysis of air.

ELECTRIZATION OF DROPS OF WATER.

Lord Kelvin, in a recent paper before the Glasgow Philosophical Society demonstrated by the aid of special apparatus, that the passage of drops of water through the air electrifies it. The electric action is much more intense if the drop encounters a solid body or a liquid surface. It has, furthermore, been proved that if a drop of fresh water strikes a salt water surface or a solid body, the air is negatively electrified, while if salt water is employed the air is positively electrified. The striking of waves against each other occasions a positive electrization of the air much greater than the negative electrization due to the fall of rain.

The electric railway to Lake Geneva will, says Alfred B. Case, president of the Chicago and Wisconsin Inland Lakes' Association, have at least sixty miles equipped and in operation by July 1. The main line of the road is from Chicago to Lake Geneva with branches to Madison, Watertown and Milwaukee. The route of the main line into Chicago is to be through Fox Lake, Libertyville and Desplaines, from this point the road parallels the Wisconsin division of the Chicago & Northwestern Railway.

WESTINGHOUSE DIVIDEND.

On December 19 the regular quarterly dividend of one and three-quarters per cent was declared by the Westinghouse Electric and Manufacturing Company. The dividend will be payable January 2.

The North Sea Canal is lighted throughout its entire extent, sixty-five miles, by twenty-five candle power incandescent lamps placed five hundred feet apart on both sides of the canal

FOREE BAIN.

Appearances to the contrary notwithstanding, the subject of this sketch, Mr. Foree Bain, is a law abiding citizen without any anarchistic proclivities whatsoever. He is simply the victim of an attempt to go against nature by mixing the cool blood of Scotland with the warm volatile fluid of La Belle France. In looks he is a mixture of the two, and a protest against both, but mentally and morally he seems to have saved the test, since in him are brought together in pleasant harmony, the sterner and more rugged virtues of his Scotch ancestry, and those softer, more suave qualities inherent in the natives of France. In other words, Mr Bain is every inch a Scotch electrician, engineer and scientist, but a French gentleman.

The principal event in Mr. Bain's life happened in Kentucky in 1853. He was born there at that time. Being a direct descendant of that Alexander Bain whose name is so often heard with that of Morse in connection with the telegraph, he inherited a love of mechanics and physics, and these talents he began turning to a good account at the age of 14 when he took up the study of engineering. His greatest work has been in the application of electricity to coal mining. He makes no claims himself, but the rest of us accord to him the honor of the pioneership in this field. It was in 1882 that he set up a complete coal mining outfit electrically operated, at Shawneetown, Ohio, the equipment consisting of dynamo, locomotive and motor, the last named being used to operate a Jeffery undercutting machine. He has numerous patents on other electrical appliances, many of which are in use. His best field, however, is as an engineer, and in this capacity he has served some highly important interests. He is just now building, among other things, a large and most comprehensive lighting station for the West Park System of Chicago, to be of 1,000 arc light capacity. All feeders are to be underground though much of the territory traversed is well out into the country.

ELECTRIC POWER IN PARIS.

M. Laffargue made an important report to the International Society of Electricity at its recent meeting in Paris upon the present status of electric light and power in Paris in which he stated that at the end of 1895 there would be in the various central stations in Paris a total power of 19,100 kilowatts, sufficient for 454,00 ten candle power lamps and for 154 motors using a total of 331 kilowatts. There has been a constant increase in the amount of electric power employed in Paris since 1889; in that year the amount used was 480,784 kilowatt-hours; in 1890, 2,284,485; in 1891, 4,671,706; in 1892, 5,987,538; in 1893, 6,986,927, and in 1894, 7,883,434.

The City of Buffalo has finally arranged with the Niagara Falls Power Company for current, and the mayor has signed the franchise.

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DIFFICULT TELEPHONE CONSTRUCTION.

Some extremely difficult telephone construction, is the subject of an article by G. P. Manning of Denver in a recent number of the Electrical Worker. When the Colorado Telephone Company first thought of extending its long distance service from Denver to Leadville, says Mr. Manning, it was a very grave question whether the enterprise would be successful, for the reason that the most available route was across Mosquito Pass, an elevation of over 13.000 feet above sea level, and at that altitude the elements are a constant menace to the maintenance of any overhead electrical construction. The engineers of the company, having no experience to guide them in this matter, first thought that a line with fifty poles to the mile and of a very heavy copper wire might stand the strain, but the first storm of the winter following demonstrated that it could not be possibly kept up with that class of construction. The attempt was then made to accomplish the result by placing 59 poles to the mile and instead copper wire using No. 6 iron wire, which is generally used for guying poles, and is capable of standing immense strain. The result was no more satisfactory than the first construction, each storm breaking down the wires and poles, which it was unable to get at for days after the storm. The company was almost at its wit's end to know what to do. It was determined, however, not to be beaten in the game. A submarine cable, five miles in length, was constructed and laboriously hauled over the pass and placed under the ground in a trench 18 inches deep, which is very near bedrock. The experiment of submarine cable was demonstrated to be a success, and in the construction of the Aspen-Leadville line across Independence Pass submarine cable has also been used.

WOULD ABATE THE SMOKE NUISANCE.

Mr. L. B, Stillwell read a paper before the Engineers' Society of Western Pennsylvania at Pittsburg on December 19th, on the substitution of electric for steam power and the consequent abatement of the nuisance which has earned for Pittsburg the pseudonym of the "smoky city."

From a series of calculations Mr. Stillwell deduced that in the central wards of Pittsburg and Allegheny a marked saving for the users of power would result, in the case of all but very large steam plants, from the substitution of electric motors supplied with energy from a 20,000 horse-power central station. He suggested two plans, one a central station located ten miles from the court-house and one installed in the city, preferably on the banks of the Monongahela near the coal supply. He considered the second plan the better.

To install a 20,000 horse-power electric plant in the city would cost, Mr. Stillwell estimated, $3,000,000, and the total annual charges, including operating expenses, maintenance, taxes, insurance and interest on investment, would not exceed $600,000. Such a plant would be capable of delivering to the premises of the users of power 17,000 horse-power. Allowing 3 per cent. for losses in the transformers and 15 per cent. for average losses in the motors installed by the users of power, the plant could deliver at the shafts of these motors 14,000 horse-power at any given time. As all the cutomers would not always be using the maximum of power which their motors could develop, it should be possible to supply from such a plant motors aggregating not less than 20,000 horse-power.

Allowing annual dividends of 10 per cent. on the $3,000,000 investment, to be added to the annual charges, making a total of $900,000 per annum, the cost per horse-power, calculating that the plant would supply 20,000 horse-power, would be $45 a year. This figure, Mr. Stillwell said, is considerably under the average cost in Pittsburg, excluding from consideration plants using more than 2,000 horse-power.

A HARROWING EXPERIENCE.

They got on a crowded Sixth Avenue elevated train at Fourteenth street, and every one looked at them because they were both young and both pretty. They talked together in audible tones with all the enthusiasm of youth, and the other passengers listened to it all with great interest.

Suddenly one of them, the smaller one, turned to her companion and with a look of horror on her face asked:

"Oh, Win, did you ever see any one killed by electricity?"

"Gracious, no!" exclaimed the other. "I should hope not."

"I did," laconically rejoined the other.

"Why, Florence, what do you mean?" demanded her companion.

"Oh, it was terrible," replied Florence in all seriousness. "I never want to see anything like it again.

"How utterly ridiculous!" remarked her friend. "Whom did you ever see killed by electricity?"

"Why," replied Florence, an aggrieved expression coming over her face. "it was the other afternoon up in Harlem. I saw a cat run over by an electric car."

The other passengers tried not to smile, but it was too funny, considering that the girl meant every word she said. Neither girl noticed the amusement of the other passengers, however, and Florence doesn't know yet of the amusement the passengers got out of her harrowing experience.—*Daily Lancet.*

A BUZZARD'S ELECTRIC TAKING OFF.

A turkey buzzard paid the penalty of having too much curiosity shortly after noon yesterday near West End.

He had evidently had a full midday meal, for he looked satisfied with the world and all the buzzards that in it are. He needed rest, however, and so perched himself upon one of the arms that hold up the trolley wire. There he sat and blinked at the sun. A couple of his brothers circled about his head, and uttering a peculiar quack disturbed the resting bird's nap; but after they had flown away he again closed his eyes and was soon peacefully dozing.

Shortly afterward a street car en route to the city hove in sight.

"See that buzzard?" said the motorman to a passenger on the front end. "Well, that bird has got into a habit of sitting on that arm every day about this time, and pecks at the trolley wheel every time it passes. Some of these days it's going to reach that wheel, and there won't be no more buzzard left."

The car whizzed on and reached the pole as the last sentence left the motorman's lips, and as it passed under the arm something was heard to fall on the car. The buzzard had pecked the trolley wheel.—*San Antonio Daily Express.*

PACIFIC CABLE COMPANY.

The promotors of the recently organized Pacific Cable Comdany held a meeting on December 19 at the office of the Central and South American Telegraph Company. The following board of directors was elected: J. Pierpont Morgan, George S. Bowdin, Edmund L. Baylies, J. Kennedy Tod, James A. Scrymser. Mr. James A. Scrymser was elected president and Edmund L. Baylies, vice-president and acting treasurer. An executive committee was appointed and authorized to arrange to increase the capital of the company to $10,000,000. It is estimated that the company will require 7,249 miles of cable to connect Japan with the United States.

DIFFICULT.

The telephone, it is said, is not making much progress in Russia. And no wonder! Fancy a man going to the 'phone and shouting: "Hallo, is that you, Dvisastkivichsmartvoiczskic?"

"No. It is Zollemschouskaffirnocknstiffsgrowoff. Who's speaking?"

"Sezimochockiertrjuaksmzkischokemoff. I want to know if Xliferomanskefflskillmajuuwchzvastowskswseibierski is still stopping with Dvisostkivchsmartvoiszski."—*The Katipo.*

The Walker Company, of Cleveland, was incorporated at Trenton, N. J., on Dec. 20. The capital stock is $2,000,000. The company will manufacture electric generators, motors and various kinds of electrical appliances.

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CONTEMPORANEOUS COMMENT.

PHILADELPHIA'S STRIKE.

It is Philadelphia this time which is afflicted with a strike, with all its serious complications. This trouble seems to have its basis largely in an attempt to break up the organization of the street-railway employes, although the men, in their demands, ask for more than the privilege of belonging to a union. Their demands relate as well to hours, wages and better conditions for work. But it is doubtful if the strike would have been precipitated, so soon at any rate, had it not been for the attack on the union.

The situation is one of vital interest. Not long ago practically all the street railways of Philadelphia were consolidated into the Union Traction company. No sooner had this gigantic organization of capital come into control, according to the press reports, than it began to ignore the organization among its employes and insisted on dealing with them as individuals. This would have placed the employes practically at the mercy of the company. It is idle to say that if the men did not like the terms offered they might quit and go elsewhere, for the one consolidated company controls all the street railways in Philadelphia. Thus there would be intense competition among the seekers for work, and one could be played against another to the detriment of all, while there would be no competition on the side of the employes of labor. The company could go into the market and name its own price, with no one to bid against it.

As against capital, organized and consolidated in the hands of a single employing company, the existence of unions is an absolute necessity for the maintainance of the rights of the workers. In the days of small industries, when there were nearly as many employers as workmen, each individual could deal directly with his employer, and on equal terms. If he could not make a satisfactory agreement with one employer he could go to another. But today in a great many lines of industry at least, the workmen can deal on equal terms with their employer, representing in himself organized capital, only by combining and acting through representatives. The attempt of the Union Traction company of Philadelphia, therefore, to deprive its employes of the opportunity to dispose of their labor to the best advantage, and to negotiate on equal terms with itself, the sole purchasers of labor in that line of business in that city, indicates a desire to secure an unfair advantage over its workmen.—*Chicago Record.*

FASCINATION.

There are thousands of telegraphers today, some of them ranking high in capability as operators, who are unable to set up an ordinary set of Morse instruments, making the proper connections to main and local batteries, relay and sounder. To such, and especially to young men entering the telegraphic field, I would say: In this respect, post yourselves at once; then take up the ordinary duplex. You will be surprised to find how simple it all is, and right here fascination will appear, just as it did to Edison, and just as it has to thousands of inventors and discoverers in every branch of science who have risen to fame, lured on by fascination. When you understand the duplex, but a few hours, or possibly minutes, will suffice to master the polarized system, and from this you will find it easy to understand the quadruplex. Having progressed thus far you will be in a position to take up readily the study of electrical measurements, dynamos, and all the different branches of the science, each additional feature mastered making the acquisition of deeper knowledge many degrees easier. Fascination is bound to carry you along, and you will be astonished at your rapid progress.

There is a chance for you as well as there was for Edison, who stood in '69 as you stand today. He got a taste and could not resist fascination, with which he joined his heart, hands and brain; and you all know the rest.

The grandest field at the present time and in the prospective future, for scientific exploration and development, is that of electricity, and if you begin early, and fair fascination smiles upon you, the pages of future history may bear in golden letters the name of some one who has read these lines.—Fred Catlin In *The Telegraph Age.*

OUR PIG-HEADED CONGRESS.

If congress could be emptied of its 75 per cent of pig-heads and intelligent and country-loving men sent to represent the people, things would soon be different. Third-class lawyers are costing this country its progress. Immediate improvement is demanded in our methods of communication. The facts are well known that 3,000 cars on 150,000 miles of road are used by 6,000 clerks to distribute 9,000,000,000 pieces of mail matter each year, and the average loss per year 300 mail cars wrecked, a dozen or two clerks killed and 150 injured. Cost of system, $75,000,000 a year.

Would it not be better to send what we have to say at the rate of 200,000 miles a second instead of thirty to forty miles an hour, especially when a 50-word letter can be wired 1,000 miles from New York to Chicago in three seconds for fifteen cents. The two-cent letter gets delivered in thirty hours. Between New York and Philadelphia, over a 300-pound to the mile copper wire, 3,000 words per minute can be recorded, and with a copper wire of 850 pounds to the mile, 1,000 words per minute can be carried from New York to Chicago. At this speed two wires could carry all the letters now exchanged between New York and Chicago, averaging each at fifty words. And yet the gang of monopolistic sycophants and bribe grabbers at Washington have no time to even consider the advisabllity of permitting the business men of the United States to have the use of such extraordinary telegraphic facilities.—*Engineering Mechanics.*

COLD CARS.

Delicate females and others who are obliged to ride long distances at an early hour in the morning suffer from cold, and contract diseases from exposure. The Columbus avenue cable cars of New York make an attempt to provide heaters, but these are only to be found in a few cars, and then seldom are in operation. This question is a vital one. With the extension of the the cable system an epidemic of influenza and pneumonia will certainly ensue, if measures are not taken to provide a system of sanitary heating which will be placed in every surface car in the city.

The performance of this work should be under the direction of inspectors appointed by the Board of Health, and the regulation of temperature should not be left to the caprice of conductors or gripmen. Thermometers should be placed in every car, and an even temperature of about 70° be maintained. Inspectors should board the cars at intervals and take the temperature, reporting the same with the time and number of the car. A system of fines might be instituted which would impress the corporation with the importance of obeying the order.

These fines should be severe enough to insure attention. No compromise should be accepted by which a few of the cars are heated and others neglected. Every car should be provided with heaters and that without delay.—*National Board of Health Magazine.*

TO RENT STORAGE BATTERIES.

The Philadelphia Electric Storage Battery Renting Company has been incorporated under the New Jersey laws, for the purpose of renting and selling batteries manufactured by the Electric Storage Battery Company, of Philadelphia, manufacturers of the chloride accumulator, and for operating various kindred and allied inventions. The capital stock of the company is $300,000, divided into 30,000 non-assessable, full-paid shares of $10 each.

Send in your subscription to THE ELECTRICAL JOURNAL.

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POWER FOR BROOKLYN BRIDGE.

Proposition to Substitute Electricity for the Cable in the Operation of Trains Does Not Meet with the Approval of Engineer Martin.

OFFER OF THE NASSAU ELECTRIC RAILWAY CO.

The proposition to electrically equip the trains which cross the Brooklyn Bridge has been under discussion for some time. The present cable service is totally inadequate to meet the needs of the rapidly increasing traffic and it was in an effort to provide increased accommodation that the suggestion was made to use electricity instead of the cable as at present. Coincident with this suggestion arose the question of connecting the Bridge system with that of one or more of the street railway lines in Brooklyn, so as to avoid the necessity of transferring at the Brooklyn end of the bridge.

The lines operating in Brooklyn were quick to see that if a combination of the right kind could be made it would mean a tremendous increase in the traffic of the road which should be lucky enough to consummate the deal, so they immediately began to lay plans with that end in view. To what extent the competition has been carried can be best determined, perhaps, by the following communication which has been addressed by the Nassau Electric Railway Company to the Trustees of the Bridge:

BROOKLYN, December 24, 1895.

To the Trustees of the New York and Brooklyn Bridge:

Gentlemen—The Nassau Electric Railroad Company is a street surface railroad in the city of Brooklyn, operating its road by electricity on many of the streets of the city and extending out in the various suburbs, including Bensonhurst, Fort Hamilton, Manhattan Beach, Coney Island and Canarsie. It has recently made arrangements for extending its lines, which will reach to the entrance of the New York and Brooklyn Bridge, and, in addition, as you are doubtless aware, arrangements have been made by which it will become the lessee of the entire railroad system of the Atlantic Avenue Railroad Company, which company already by many of its lines runs directly to the entrance of the Brooklyn Bridge.

The Nassau Electric Railroad Company hereby asks permission to operate its cars upon the Brooklyn Bridge, so that persons can take such cars in New York city and travel directly to their destination without change. In making this proposition, the Nassau Electric Railroad Company offers and agrees to operate the entire system of railways upon the bridge and will assume the entire expense of making such changes as may be necessary in adapting the structure for surface cars running upon the same, and also all of the expense of operating and maintaining said railways.

The railroad company will agree to carry passengers across the Bridge, both to and from New York city for nothing.

The Nassua Electric Railroad Company, in equipping the different railroads to be operated upon the Bridge by electricity, could provide for the carrying of over forty thousand persons per hour on that structure. By this arrangement the traveling public of the city of Brooklyn, residing upon the various lines of railroad managed by this corporation, would be enabled to reach the city of New York without any change of cars, and more comfortably than is at present possible, while other persons, desiring to use the bridge, would receive a benefit by being enabled to cross the bridge for nothing.

That this scheme is entirely feasible, the Nassau Electric Railroad Company is willing to show by agreeing to equip the bridge in the manner proposed and to operate its road for one year, and, if at the end of that time, it has not demonstrated its entire mechanical practicability, it will then remove all of its fixtures and equipments from the bridge and restore the same to its present condition, upon condition that if it is practical that then an agreement should be made between it and the Bridge permitting it to run its cars over the same for the period of fifty years. That as an evidence of the belief of the Nassau Electric Railroad Company in the practibility of this scheme, it hereby offers and agrees to execute a bond in the sum of $250,000 for the performance of the above proposition.

Trusting that this matter will receive careful consideration and that this company may have an opportunity to further explain the details of the same, I remain, Yours most respectfully,

NASSAU ELECTRIC RAILROAD CO.
P. H. Flynn, President.

The attitude of the management of the Bridge can be gathered, too, from an interview which was had with Mr. C. C. Martin, Chief Engineer and Superintendent of the Bridge, whose views on the electrical equipment of the bridge are reported as follows:

"The trolley cars would not meet the demands of travel as the cable cars do. Each trolley car accommodates fifty or sixty people. It takes just as long to load one trolley car as it does four cable cars, which hold four hundred people. Congestion would necessarily follow. Then if you operate trolley cars on the bridge you invite accidents by taking a large amount of risk. It will be necessary to rely upon the judgment of hundreds of motormen who are to determine if they are running at proper headway. The cable cars are run on a different system. The headway is regulated by one man who starts them. Once fastened to the cable the headway cannot be changed. By the cable system trains are run back and forth with the regularity of a pendulum. There can be no delay. Trains can be emptied within a few seconds every time and switched to another track just as quickly. There is no variation at any time. For years the system has been followed and 392,000,000 people have been carried on the cars with only one accident. I maintain that a man is safer on a bridge cable car than he is in his own bed. More people have been killed in folding beds than have been killed on the bridge cars.

"The strictest regularity is necessary in order that 120,000 passengers may be carried a day. Such regularity could not be secured if the trolleys were run across the bridge in place of the cable cars. As to whether it is practicable to run trolley cars across in addition to the cable cars, it is easy to show that there is no room for more tracks, and, again, the bridge was not constructed to bear the additional weight. The arches above the cable tracks are not strong enough to furnish roadways for the trolley lines, and if the arches themselves were strong enough, too much weight would be imposed on the inside cables, which now bear the greatest weight. The only place left is beyond the outside cables. The cost of building suitable accommodations for the trolley tracks beyond those cables would be enormous.

"About eight months from now we shall lower our headway from ninety seconds during rush hours to forty-five seconds when our terminals are finished. Then with our electric switching arrangement, which will take the place of our switch engines, we shall save several seconds more. Our capacity is now 16,000 passengers an hour. When we are able to run on forty-five seconds' headway our capacity will be at once doubled to 32,000 an hour. Gaining several seconds more by the electric switching we shall probably be able to reach a capacity of 40,000 an hour. As we now carry 120,000 a day we shall, with the improvements, be able to accommodate 960,000 a day or 840,000 more than we carry now. The trolley roads can never accomplish what we can on this bridge with the cable road.

"On the new bridge, from the foot of Broadway, trolleys and elevated roads may be operated because the bridge will be built with that end in view. Our bridge is 85 feet wide. The new bridge is to be 118 feet wide and it will have ample room for trolleys and elevated trains so that the congestion which would follow were trolleys operated on this bridge need not be feared on the new bridge. Some of the most eminent engineers of Europe have watched the operation of our cable road with wonder and have declared that it meets the demand better than anything else could."

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PROF. NIPHER'S "ELECTRICITY AND MAGNETISM."

The first impression in looking over this book is one of favor on account of the numerous sensible demonstrations of many of the fundamental theorems which must be used repeatedly in the elementary study of the theory of electricity and electromagnetism. In this respect the book approaches in treatment the magnificent treatise by Gerard. (Lecons sur l'Electricite.) Much of the matter on potential and electrostatics which occupy separate chapters in the early part of the book do not have a great deal of attraction for the engineering student since all the theorems of these chapters which can in any way serve him have already been covered by his study of theoretical mechanics. The chapters following contain much which is of interest to the engineering student, though the book is not one which is likely to come into general use in technical schools. In the average technical school a mathematical treatise on the elements of electricity and magnetism (which the book purports to be) is not likely to be used as a text book, but may fill an essential place as a book of reference.

It is not so much of the book under review that we would write, as of many of the points in the book which are likely to attract the attention of any one who has had some experience in the application in the arts, of the laws of electricity and magnetism, and in teaching the theory and practice of the various applications. One of the first points which strikes one in carefully looking over the book is the way in which Prof. Nipher applies the good common sense principle of Ohm's Law to the flow of almost every sort of force, including electrostatic force, electromagnetic force, and the electric current. This of itself is of considerable interest and makes the chapter on capacity and energy materially more satisfactory to the averge student than is ordinarily the case in such a book. The chapters on magnetism and the electric current contain a great deal which must be known in the present state of the art to every successful man who is engaged in the design and manufacture of alternating current machinery. In a few respects the writer would take strict exception to statements made by Prof. Nipher, but mostly in minor points. One of the points which is scarcely debatable is the designation of the square root of the mean square of an alternating current as the "virtual current" instead of the effective current. It is desirable as a matter of convenience to the student that one term be used in all cases for the square root of the mean square, and the term "effective" has come into general use, while the term "virtual" seems to be confined to a few text books. The American Institute of Electrical Engineers has given its sanction, at least indirectly, to the term "effective" and it has been generally adopted by American engineers of prominence. It is therefore to be hoped that Prof. Nipher will revise his usage.

In the chapters on variable currents and alternating currents we have the usual mathematical discussion which, in this case, is very largely illustrated by the use of graphics and by numerical examples, but much of the mathematics is scarcely applicable to practice and therefore does not have a great deal of interest to the average man. The definition of self induction is arranged in an unusually satisfactory manner, and it is a satisfaction to find that Prof. Nipher explains the effect of iron cores by introducing a term representing the average permeability of the magnetic circuit into his formula which represents self induction. This is a practice which is too little followed by text-book writers, but which is of the greatest advantage to the student in giving him a clear physical idea of what takes place in the alternating current circuit which surrounds an iron core. It is surprising to find that Prof. Nipher uses the term "coefficient of self induction" instead of the approved term, "self inductance." As far as the writer has been able to discover, the term "inductance" does not appear in the book. It certainly does not appear in the index. The magnetic quality of iron and the effect of iron cores in an electric circuit is discussed in a separate chapter where hysteresis curves, curves of magnetization, formulæ for eddy currents, and similar details are thrown together.

The book is closed with a chapter upon units which doubtless would be interesting to the undergraduate student of mathematical physics. In this chapter it is stated that the American Institute of Electrical Engineers calls one C. G. S. line of magnetic force a "Weber," but the statement is scarcely correct as the name has simply been recommended by a committee of the Institute. Prof. Nipher states the matter properly in regard to other magnetic units.

The series of problems which are given at the close of the work are well chosen to illustrate the physical meaning of the formulas, but those which touch upon the field of the engineer and designer do not fairly represent practical machinery, and consequently might have been materially improved. A curious slip is made in the statement that the no load current in a transformer depends directly upon the self inductance of the primary winding and affects the all-day efficiency of a transformer. The component of the no load current of a transformer which depends only upon the inductance must be a strictly wattless one, and consequently cannot affect the all-day efficiency of a transformer. though it may affect the plant efficiency to some extent by causing a $C^2 R$ loss in the leads and dynamo. The all-day efficiency of a transformer is dependent almost wholly upon the magnitude of the losses caused by hysteresis and foucault currents in the iron core, which have nothing to do with the coefficient of self induction. It is also curious to find the electrical efficiency of a shunt-wound dynamo called its "economy of operation," which it by no means represents except in ideal cases where friction, foucault currents, and hysteresis are neglected.

There are several minor typographical errors in the book, but on the whole the execution is good. Prof. Nipher evidently prefers to spell coulomb without the first o, a culomb is apparently the only spelling used for that word in the book, but this is an innovation which is scarcely likely to be received favorably.

Altogether the book is one which is likely to be received favorably by teachers of undergraduate students studying elementary mathematical physics, as it fills a gap in the continuity of text books upon mathematical electricity and magnetism which are printed in the English language. It is also likely to prove of use as a reference book to undergraduate students of electrical engineering who will find that its clear demonstrations of a large number of fundamental theorems will save them the annoyance of consulting works in foreign languages.

The publishers of the book are the John L. Boland Book and Stationery Company of St. Louis.

THE NEXT STREET RAILWAY CONVENTION.

The executive committee of the American Street Railway Association held a meeting in St. Louis December 9 for the purpose of arranging the preliminaries in connection with next summer's convention. Among other matters provided for was the use of the Southern Hotel as headquarters and of the Olympic Theater, just across the street from the hotel, for the meetings. The selection for an exhibition hall has not yet been made. The local association is planning to give the Association a thoroughly enjoyable time and the hope is entertained that from every standpoint the next convention may be one of the best in the history of the Association. The executive committee has given considerable thought to the selection of subjects upon which papers shall be read at the convention, and selections are being made of writers which will insure this feature of the work being both interesting and instructive. Some of the members of the Association who appreciate what it is to be provided in advance with convenient and suitable quarters during the convention, are already making their arrangements along that line.

The subscription price to the ELECTRICAL JOURNAL is $2.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

Brooklyn has 17,000 miles of electrical conductors. Of this amount 13,000 miles are telephone wire, the rest being divided among other branches of the service. More new lines were strung during the present year than existed altogether previous to 1887.

The Pacific Cable Company was incorporated December 15 at Trenton, N. J., with a capital stock of $2,000,000, for the purpose of laying, operating and maintaining an electric cable across the Pacific Ocean. Among the incorporators and principal stockholders are Abram S. Hewitt, D. O. Mills, C. M. Dodge, Fred D. Grant, and Wager Swayne, all of New York; J. J. Hill, of St. Paul; Z. S. Spaulding, of San Francisco; John H. Brown ing and Mason W. Tyler, of New Jersey.

Light and Power.

Rockford, Ill., has passed an appropriation providing $70,000 for the building and equipping of a municipal lighting plant and its maintenance for a year.

The Common Council of Philadelphia has appropriated $62,000 towards establishing a municipal lighting plant. It is a very small appropriation but is intended only as a starter.

In the mountains of the West the miners have hitherto been largely dependent upon water power to operate their stamp mills, and the failure of the water supply at times has caused them great inconvenience and loss. This trouble will in future be obviated in many instances by the introduction of electric power. The water power of the mountains is practically unlimited but it cannot always be brought to the point where it is most needed. By generating electric power, however, at any given point it can readily be conveyed to any other point, and this is what is now about to be extensively done.

The Engineering and Mining Journal in its issue of December 14 calls editorial attention to what it designates as "The Calcium Carbide Gas Bubble." It says the Willson Aluminum Company, whose stock is selling at $1,000 per share, par value being $100, has never made a ton of the "Carbide." It states that the company received recently $300,000 in part payment for rights of manufacture sold to a Chicago subsidiary company, and that it has already paid a dividend of 60 per cent, and expects to pay another of 50 per cent. shortly. The Journal suggests that the whole thing is a gas bubble (acetylene) likely to burst at any moment.

An ordinance is at present before the City Council of Chicago, which, if passed, will provide active competition for the Edison Company, which hitherto has had a monopoly of the field. The new company is known as the American Gas Engine Electric Company, and it asks for a franchise extending over twenty-five years and privileges covering a large area of the business district of the city. The new company proposes to charge for incandescent lamps only 8-10 of a cent per lamp per hour, as against one cent charged by the Edison Company. It proposes also to pay two per cent of its gross receipts to the city for the first ten years of its contract and three per cent for the remaining fifteen years.

There is a steam coach on exhibition at Atlanta lighted by electricity by the Moskowitz system which is new in actual practice if not in principle. It consists primarily of a dynamo built on the truck, the armature forming a sleeve on the axle. When the speed of the cars has reached ten miles an hour the dynamo will generate enough current of the proper potential for lighting purposes. About one-half the capacity of the generator is employed in lighting the car, the remainder being employed in charging a battery of storage cells which in turn are used to light the car when it is not running. In a 7 hour run it is calculated that sufficient energy can be stored in the cells to light the lamps for 12 hours. The car is equipped with 17 sixteen c. p. lamps and 17 eight c. p. lamps.

Railways.

A trolley wheel, it is claimed, will run 11,000 miles before it becomes useless.

The Board of Legislation of Cincinnati has adopted a set of resolutions and forwarded them to the Street Railway Company asking for lower fares for the working people.

Special theater trolley cars are in course of construction for the Brooklyn Heights Railway Company. They are to be of the drawing room style, and will rest on two trucks. The seats will be movable chairs upholstered in plush. The cars will, of course, be heated and lighted by electricity.

Several Cleveland capitalists have formed a company to be known as the Jacksonville and Tampa Improved Railroad Company and will build an electric line from Jacksonville along the coast about eighty miles to Daytona, thence inland forty miles to Sanford. The company will get from the State a bonus of 8,200 acres of land for every mile of railroad. Operations will begin sometime during the present year.

A novel plan of providing motive power for railroad purposes is under consideration by some of the mine owners in Northern Michigan and gives promise of developing into something practical. From Ishpeming to Marquette is a distance of fifteen miles and there is a fall of 800 feet between the two points. A motor car will be attached to every train of ten or fifteen cars. This motor car will contain a dynamo. On the down grade no brakes will be applied but the motor will be thrown in gear and the force otherwise wasted will be converted into electrical energy. This will then be transmitted to a trolley line and taken off again by the empty trains making the up trip. The weight of the loaded cars will be sufficient to overcome the loss of power through friction and an electric road will be the result which will practically run itself. Keeley?

General News.

The engineering firm of Pierce & Richardson, of Chicago, has been engaged to draw plans and specifications for a municipal lighting plant for the town of Henderson, Ky.

Through the leakage of electric current from underground wires in Chicago a few days ago and the consequent charging of a portion of an alley cross-walk a number of people received more or less severe shocks. The incident created some fun for a crowd of onlookers.

Mrs. Greshoff, of Baltimore, has been awarded $3,000 damages by a jury for the death of her son who was killed by coming in contact with an electric wire on the top of the Auditorium building in that city. The jury stipulated that the Brush Electric Light Company should pay $2,000 of the amount and Mr. Kernan, the proprietor of the building, $1,000. Notice of an appeal by the defendants was given.

The supreme court of Colorado has confirmed the verdict of a jury awarding heavy damages in a case where a party was severely injured by coming in contact with a falling wire. The position held by the court was that companies stringing wires were bound to exercise extraordinary care and caution. Its obligation in that respect exceeding that of a common carrier by reason of the dangerous character of the business.

Mr. A. T. Hutchins of Detroit, Mich., has invented and patented a device intended to afford protection from falling wires. The device consists of a wire similar in purpose to that of a lightning rod on a house. The top of the wire is split like a fork, the other end being connected with the ground. The intention is to have it catch a falling wire and carry the current to the ground. Just how this would operate with a heavily insulated wire does not appear. If the fork did not perforate the insulation the end where the break occurs would still be dangerous. In the case of bare wires some such arrangement might be practical.

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ELECTRO-THERAPEUTIC DEPARTMENT.

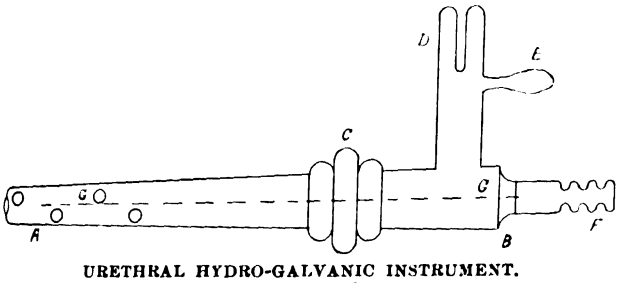
URETHRAL HYDRO-GALVANISM.*

New Instrument For Local Electrization of Mucus Membranes.

The delicate structure of the mucous lining of the urethra, especially in males, is more irritable and sensitive during the course of any inflammation.

The direct application of any electricity has in many cases over stimulated and has thereby increased rather than diminished the inflammation and while some patients will tolerate the application, in others it cannot even be borne.

These difficulties have led me to construct an instrument for the treatment by electricity using the principle of the electric bath. The instrument is illustrated and described as follows:



URETHRAL HYDRO-GALVANIC INSTRUMENT.

A to B—A conical hard rubber tube.

A—Small holes for the passage of the fluid into the urethra.

C—Movable soft rubber ring.

D—For the attachment of one rheophore of the battery.

E—Stopcock.

B to F—Corrugated metal tube for the introduction of the fluid.

G—Platinum wire, lining the hard rubber tube.

This instrument is lined with a platinum wire for the conduction of the electricity.

Modus operandi: The fluid used may be salt water, bicarbonate of soda, or any other medication as the symptoms may indicate. As a reservoir for this fluid the writer uses a glass cylinder so as to ascertain by sight the quantity of the fluid used. The lowest part of this cylinder and the portion of the instrument "B" "F" is connected by a rubber tube for the transmission of the fluid through the instrument. The glass reservoir is placed at such a height that the fluid will, by its own gravity, enter the parts to be electrified without any undue pressure.

For the indifferent pole use either a pad placed on any part of the body or a sponge electrode in the hand—the latter is preferable. The active pole of the battery is connected with the instrument at "D."

The end of the instrument at "A" is slightly lubricated and is introduced into the meatus so far that the conical part fills up the orifice.

The instrument has been made conical in order that the orifices may be filled as the sizes of the meatus and calibres of the urethra differ in individuals. When the conical tube has been inserted as far as it will go, a rubber ring "C" is pressed against the outside of the meatus to prevent any leakage of the fluid. One hand only is needed to keep the instrument in situ, while the other one is used to turn the stopcock "E," which allows and controls the afflux of the fluid to the parts, and also to regulate the current strength of the battery.

The galvanic current will be used in strength from 5 to 20 m. a. according to the effects desired.

The stopcock should be so regulated as to keep the parts well filled with the electrified fluid or even dilated so that it enters all the rugæ of the canal.

If it is desired to change the electrified fluid the instrument may be withdrawn, slightly, to allow an escape of the solution and then the stopcock may be turned on to give a fresh supply.

The average time for a seance will be about ten minutes. Before finishing the treatment the current of the battery should be slowly reduced to zero.

THEORY AS A PRACTICAL APPLICATION.

The theory is to electrify the fluid by the continuation of the current through the water to the platinum wire of the instrument, the same as in an electric bath. For example; put a coin in water then place both poles in the water then turn on a strong current and the water is so strongly electrified that the coin cannot be removed.

The theory is well expressed by Newman Lawrence—"All that is necessary to insure that the water or other fluid is electrified when it reaches the patient is to have the nozzle so constructed that the jet or jets of water form continuous streams for a reasonable distance after they leave the metallic conductor within the nozzle."

HISTORY.

All that has been said about the electric baths has reference to the origin of this method. Beard and Rockwell have called attention to Hydro-electric Applications. Boudet's, of Paris, methods have been written of by Dr. Larat in 1892. Dr. Max Einhorn has used the direct application through the fluid of the stomach. The writings of W. H. Hedley, of Brighton, England, and Newman Lawrence, of London, deserve mention. These last two have written on "Hydro-Electric Methods" and "The Electric Douche" and "Hydro-Electric Therapeutics of the Constant Current." T. Clemens has written of "Die Galvanische Douche," Deutsche Klinik Berlin in 1859 and 1860.

As far as I am aware the first practical employment of hydro-electric applications was made by Dr. W. H. King of New York, who constructed, about four years ago, a rectal electrode for hydro-electricity. A drawing of that instrument appeared about the same time in Waite and Bartlett's catalogue.

The writer has used hydro-galvanism in the female bladder three years ago. The instrument used is described in Tieman's reprints No. 10. The paper was read before the American Electro-Therapeutic Association in 1893, in Chicago. He used a guarded electrode in the water which filled the female bladder.

Dr. Margaret A. Cleaves read a paper at the meeting of the American Electro-Therapeutic Association in New York, September, 1894, on "Special Hydro-Electric Applications," in which she exhibited a series of her instruments for special parts of the body.

The present illustration of the writer's instrument does not infringe on any instrument in hydro-electric applications before presented.

THERAPEUTICAL USES.

The instrument is intended for general electric galvanization but can be used also with the faradic current if an operator finds indications to do so. The present paper deals only, however, with hydro-electric galvanism. The most important part will be for stimulations of the mucous lining, healing of ulcers or ulcerations, absorption of pathological conditions. If the fluid be properly medicated cataphoresis and electrolysis may be applied. Experiment;—Galvanic battery, six cells for six minutes. Instrument positive pole, platinum needle negative, in a solution of iodide of potassium of one drachm to one ounce of water. Iodine at the positive pole, and for a considerable distance towards the negative pole, manifested by a deep brownish yellow color, proved the electrolytic action.

DISEASES.—ABORTIVE URETHRITIS.

The failure in abortive urethritis has been due principally to the fact that the inflammation has caused such an irritable state that it is impossible to introduce an instrument or medications. The important part is to make use of a certain stage in which the inflammation has assumed such a degree of irritability that the instrument under consideration can be used. This or a modification of it can be used with more ease than any other instrument.

*Paper read by Dr. Robert Newman of New York, at the Toronto Convention of the American Electro-Therapeutic Association, September 5, 1895.

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Electrolysis given by a metallic electrode, or bulb, is apt to create more inflammation and possibly a degree of cauterization. The hydro-electric galvanism is milder and has better chances to abort the urethritis and prevent inflammations.

Chronic urethritis and all pathological discharges will be more safely cured by this method than by any other which dilates the calibre of the urethra and puts the mucous lining on a stretch, cleanses and washes all parts alike.

The electric current is equally divided in every part of its course, the milder application of electricity will be better tolerated by the patient and the curative process takes place which will not be accomplished by direct applications. It may be objected to that by an introduetion of an instrument of two inches, the deeper portion of the urethra may not be electrified. By practical observations, however, it has been found that any part of the urethra can be electrified and if the instrument be rightly handled the fluid will penetrate any depth of that organ. If any doubt arises we have two means to make a sure thing still more certain. First is to hang the reservoir containing the fluid higher, in order to increase the pressure from above; experience has shown that under such circumstances the fluid will even enter and fill up the bladder. The other is to have the instrument made longer. It has been found from experience, however, that the latter is not necessary.

Chronic urethritis of the deep urethra can be cured in the same way as before described. This is a very important use of the method as this state of ailment or disease has been a stumbling block in treatments and many ways of medication have made things worse. The writer has often met with patients who have been made worse and driven almost to despair by the treatment of a celebrated specialist whose favorite method was to inject a strong solution of nitrate of silver. It stands to reason that this treatment cannot cure as the strong solution will diffuse itself all over diseased and normal tissue.

EXCORIATIONS AND ULCERATIONS

Excoriations and ulcerations, particularly the latter, are very hard to cure in the urethra by ordinary means. Our hydro-electric galvanism will breach over the first part of the treatment in which the irritability of the parts prevents the application with direct electricity. After a few séances with this method, treatments of direct electricity may be used.

A theory is here propounded that this method may be used in tortuous urethral strictures of small calibre where by its use the tortuosity may be lessened and the stricture modified and partly dilated, and lead the way to the usual treatment by electrolysis. This is not considered necessary, but some operators may find this an aid to begin the treatment in urethral strictures when they find it impossible to introduce an electrode.

DISEASES OF THE PROSTATE.

Diseases of the prostate consist mostly of inflammations and hypertrophies, in which cases this method appears to be very valuable. Introduction of instruments is generally very painful, and often causes derangements of the bladder. If the hydro-electric galvanism will, and undoubtedly does, pacify these parts it will facilitate the treatment afterwards of other applications.

It is a new field in prostatic diseases, and the probability is that it will cure some maladies of the prostate gland, superseding the former doing-nothing plan, and the present tendency of cutting and mutilating operations.

DISEASES OF THE BLADDER.

Diseases of the bladder have been treated by this method by the writer some years ago with success, whereby capillary or siphon arrangements with this instrument may be used to fill the bladder with fluid or simple water A longer instrument, by which the fluid enters the bladder, was used three years ago for females. But another catheter for direct injections has been constructed by Dr. Margaret A. Cleaves.

CONCLUSIONS.

1.—Hydro-electric methods are nothing else than the electric bath localized to a certain part of the body, the current transmitted by pure or medicated water electrified.

2.—The instrument shown will not supersede the direct electric current.

3.—The instrument will, however, be useful to apply an electric current indirectly through the fluid when a direct electrode may not be tolerated.

4.—The instrument will pave the way for a later regular electric treatment.

5.—The applications have been made with the galvanic but may be used for other currents as indicated.

ELECTRIC ENERGY AND LIVING MATTER.

In a recent issue of the "Revue Generale des Sciences." Dr. M. Springer refers somewhat at length to Professor D'Arsonval's researches on the subject of electric energy in living tissue. After having demonstrated that matter is the support of force, but that it is otherwise distinct, M. d'Arsonval shows that mechanical thermic power must be aided by electric energy which includes all forms of power heretofore known. All forms of energy can, furthermore, be transformed into electricity. He considers a living being as a transformer of energy, having a mode of action peculiar to itself. Electricity possesses the power of setting in action all the vital properties of organic matter. It may go through the body as a constant or interrupted current. The latter causes a violent excitation of nerves and muscles; the former when moderate does not cause excitation, but when it is strong electrolytic action is produced. The intensity is governed by the amperemeter. The constant current at low tension is produced by the battery; at high tension by the static machine. After having formulated the law that the intensity of motor and sensory re-action varies with the potential at the point of excitation, the author introduces a new idea in medicine, namely that electric excitation always gives identical results when its form is the same, whether the excitation is produced by the static machine, battery, or induction coil. This does away with the erroneous idea that physiological effects differ with the source employed.

The excitation produced by two identical currents, but in reverse direction, following one another without interruption through the tissues does not cause any organic destruction by electrolysis. For this reason M. d'Arsonval has introduced into electrotherapy the employment of the sinusoidal alternating current, the properties of which are very precise since at low frequency and low potential its passage through the organism is not felt, although it increases changes of nutrition to a considerable extent. With medium potential and frequency violent contractions of both striated and nonstriated muscles occur but without pain. By increasing the potential a current is produced which apparently causes death. But this is only apparent and is due simply to inhibition of respiration, for in America several criminals supposed to have been electrocuted have been restored to life. Finally, alternating sinusoidal currents of high frequency and high potential give rise to very unexpected phenomena which apparently might be employed with advantage by the therapeutist. Results applicable to clinical uses have not yet been obtained, but they enable us to see the import they may have in the future in the treatment of infectious diseases, since the experiments of d'Arsonval and Charrin who injected the pyocyanic bacillus into the tissues of a living animal and obtained attenuation.

ELECTRO-STATIC BATHS IN CHOREA.

Regnier reports in a recent number of the Archives de Neurologie a case of chorea rapidly cured by electro-static baths. The patient had an attack of articular rheumatism at the age of 7, complicated with endocarditis. The second attack occurred two years later, and was followed after fifteen days, by a severe attack of chorea. Daily electro-static baths of thirty minutes' duration were ordered on the third day of the disease, and continued for three weeks, afterwards being gradually dropped. The effect from the first bath was quite manifest, each bath was followed by progressive diminution of the choreic movements, and in two months recovery was complete.

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JAMES PRESCOTT JOULE.

Distinguished Experimental Philosopher. Born at Salford 1818. Died 1889. One of the founders of the modern theory of the conservation of energy. For him the unit of work was named.

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The Electrical Journal.

Vol. 1. CHICAGO, JANUARY 15, 1896. No. 16

ALTERNATING CURRENT METER.

A New and Unique Method for Determining Faradic Dosage for Purposes of Record—Not Necessary for Operative Employment.

BY S. H. MONELL, M. D. BROOKLYN, NEW YORK

A former paper by the present author described a new induction-coil apparatus with a number of original improvements designed by me to increase precision and efficiency. In this second paper I now present to the medical profession my method of dose measurement and registration, which, so far as inquiry discloses, is the first practical method with a scientific basis.

I am met at the outset of my proposition to measure and record induced medical currents by the curt remark that it cannot be done. With this declaration before us, let us review a group of contemporary statements upon the subject of faradic dosage. The authority for each will be easily recognized by all familiar with the literature of electro-therapeutics.

1. "A bar to the progress of faradism is the impossibility of satisfactory therapeutic measurement. Edelmann's faradimeter is incomplete and, I must even add, misleading as a physiological or therapeutic measure."

2. "The Edelmann faradimeter, which is not by any means, as was intended, a measure of faradic electricity, is too complicated and expensive for the practitioner, . . . and is merely a deceptive snare for physiological or therapeutic purposes. The strength of the current would be far better approximated by indicating the nature of the coil and the resistance offered than by the volt scale of this faradimeter."

3. "Unfortunately we have no means of measuring accurately the dose of faradism, the only means at our command being the millimetre scale placed at the side of the coil. This is a very rude method, indeed, but it is all we have at present."

4. "It is much to be regretted that we have no means of accurately measuring the therapeutic dosage of the faradic current."

5. "The old attempt to measure the faradic dose by a coil movable over a primary core, on a graduated scale, was so unscientific and inadequate as to be ridiculous."

6. "It is the ability to record the doses of the current to which must be ascribed the rapid progress of galvanism. To give the necessary impetus to faradism we must obtain this same precision . . . and toward this end my efforts have been directed ever since I realized how seriously this valuable remedy was affected by its vagueness and uncertainty; and as early as 1886 I sought to approximate dosage by a defining and precising of details."

7. "The precise measurement of the faradic current for therapeutic purposes has not as yet been satisfactorily attained. The method heretofore in vogue, of measuring on a scale the distance the secondary coil is advanced over the primary, is inaccurate and delusive—in fact, means nothing—since the battery current varies with use; and no estimate is taken of the variable resistance encountered in the external circuit, which is altered by the location of the electrodes, by their size, and by the distance between them. The fact that this current possesses the same two qualities as the galvanic current—pressure and volume—makes it evident that we must in some manner estimate the relative voltage and amperage of the current employed in order to arrive at a practical conclusion of its comparative value."

The striking remark of Engelmann's, which closes the second comment cited above, although not observed by the writer previous to the preparation of this article, foreshadows what is substantially accomplished by the method to be described in this paper, and which was originated by me, January 29, 1894. My method also takes into account what is suggested as necessary in comment number seven, but before proceeding with descriptive details, certain relative facts require to be understood. These are as follows: No automatic meter or measuring instrument is required to select the proper dose of faradism for a patient, or to adjust it to the needs of therapeutic use. Direct currents need such an indicator, but induced currents do not. The educated skill of the operator regulates the dose, and does it adequately. The existing need is for a standard system of recording the dose administered, and thus impart uniform value to the reports of clinical cases, and introduce precision and definiteness into the special literature of the subject.

The accepted dose measurer of the constant current is the milliamperemeter, adopted universally within half a decade, and which in general estimation has lifted the galvanic current from empiricism and placed its therapeutics on a scientific basis. Let us, therefore, note exactly what the milliamperemeter accomplishes and what part it plays in the dose record, in order that we may better understand the problem before us in attempting to measure and record the dose of induction currents.

To enable separate observers to compare and repeat results in clinical cases treated by galvanism, we should take into account every factor which affects the action of the current. A comprehensive record must necessarily inform us then, on the following points: 1. Surface area or type of electrodes—which range from needles, sounds, tips, etc., to small or large pads, or water-baths, or may be clay, copper, zinc, carbon, platinum, steel, tin, brass; or covered with sponge, cotton, felt, etc., determining conducting power and density of the current. 2. Situation of both positive and negative electrodes during treatment. 3. Tissues treated and their pathological state, symptomatic conditions, etc. 4. Time and frequency of administration. 5. Reading of the milliamperemeter, or current volume.

Clinical reports of these particulars, with results of treatment, would be complete: and while of the various factors the meter furnishes but one, it supplies the last essential to the dosage of galvanism.

When we enter upon the problem of faradic dosage we find the factors no fewer, but differing in character. These are now: 1. Character of the current, as determined by the coil employed. 2. Description of electrodes and their situation during treatment. 3. Rate of current interruption. 4. Tissues treated, condition, etc. 5. Current strength. 6. Time and frequency of application.

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The missing link in our clinical record is a means to state the current strength. We cannot sufficiently indicate the rest. How shall we measure the current strength? Now, certain features enter into the measurement of a constant current which are eliminated from the case of an interrupted or alternating current. The therapeutic requirements of the two are inherently dissimilar. The galvanic current is silent in its flow and physiological activity. Without observing the deflection of the galvanometer needle, or making other test, we may be in doubt whether or not the battery is in action until the current is strong enough to be felt by the patient, and as a guide to treatment the patient's sensations are incompetent. The predominating quality of the direct current is volume—its voltage being relatively small in medical uses—and "volumes" cannot be determined by the eye or ear of the operator. On the other hand, the induction apparatus, through its break-piece, which is the essential, the very life of this form of electricity, gives forth to the ear and sight unmistakable evidence of action; and its current is one of predominating force, of insignificant volume, chiefly mechanical in its physiological effects, and nearly devoid of chemical properties. It therefore requires no peculiar safeguard, like the milliamperemeter, against an excess of electrolytic or cautery action within the tissues. Moreover, owing to the feeble power of the dissociation possessed by the constant current, an enormous range of uncertainty enters into every galvanic application without a meter in the circuit; for the actual current strength—*i.e.*, dose—from the same number of cells and with the same electrodes will vary greatly with the degree of resistance of the skin, etc., so that similar conditions of E. M. F. are no guide whatever to similar doses and effects. With the galvanic current, with either 5, 10, 20 or 40 cells E. M. F., and with the electrodes in a glass of water, I can cause the meter to vary from 2 to 250 M. A., without altering the electrodes or the battery, simply by lessening the resistance of the water.

The nature of the induction current, however, is such that little of this great variability occurs in clinical applications when similar conditions of treatment are repeated. A given E. M. F. will produce a definite current strength from a given induction coil, and repeat it under the same conditions as often as desired. The influence of slightly varying skin resistances of different parts of the surface of the body is insignificant in the case of the higher voltage and penetrating capacity of currents from induction-coil apparatus. We have, in fact, but two practical conditions of resistance to consider in faradic therapeutics, viz., the greater general resistance of the skin in external treatment, and the lesser resistance of the moist, mucous surfaces of the cavities of the body. Thus presented, we observe that the problem of faradic dose-measurement, or means of record, is much simpler than was that of the now solved problem of galvanic dose-measurement; for if we can by any means indicate the electrical or mechanical energy of our induced currents under conditions identical with their clinical administration, we are assured of obtaining the same energy for therapeutic uses and repeating it upon patient after patient with substantial accuracy. A standard indicator of current strength will accordingly serve as a subsequent dose-register for future applications from all similar apparatus.

The methods so far suggested for measuring the dose of induction-coil currents are as follows:

1. A strip of suitable material, wood, celluloid, or vulcanite, is placed at the side of the coil and marked in fractions of inches, or of the decimal scale. The current increases in strength as the coil overlaps the primary, and the dosage is taken to be the extent of overlap during the seance. The capabilities of measurement are exhausted when the overlap is complete, and the record must be alike for one or four cells, or No. 36 or No. 16 wire coils. It is not surprising that this attempt to measure current strength by a foot-rule was never scientifically successful.

2. The graphic method of marking the current waves; a purely fanciful idea adapted for black-board illustrations of certain currents characterized by sufficient amperage to operate the tracing-pencil, but neither practicable outside of the expert's hands, nor capable of demonstration at all with the currents of higher tension and frequency and consequently smaller amperage now performing so much of the therapeutic work of improved induction apparatus.

3. The Edelmann faradimeter.

The name faradimeter is felicitous and suggestive of a proper method, but it has never reached a more practical stage of development for ordinary use than have ships for navigating the air. It is a complicated, expensive, though highly scientific, meter for the voltage of the current in short circuit; and since therapeutic applications involve the interposition of body-tissues this instrument has no relation whatever to a physiological unit.

4. Micro-coulombs were asserted to be the electrical unit by which to express faradic measurement, but when we turn to the coulombmeter for aid we are practically where the faradimeter left us.

5. Voltmeters, ammeters, and wattmeters that fill successfully their proper places in measurements of large commercial currents, do not supply us with any means to meter the small currents of medical coils. If a miniature wattmeter could be made to work it would be too expensive for general use.

6. Rate of interruption.

It is assumed that if this is stated in mathematical terms a certain amount of precision will be secured. Other factors, however, affect the question of dosage too materially to place dependence solely upon knowing the frequency of the periods.

This brings us to consideration of the method proposed and successfully employed by me for upward of a year. It is a method which, in my hands, has passed beyond the nascent stage of hopeful theory into the practical demonstration of constant and satisfactory use. The method was first made possible when I introduced by non-inductive fluid current controllers into the secondary circuit. They easily supersede in value all previous methods of regulating current strength.

The switch board of my induction apparatus presents a rapid interrupter (vibrations of 10,000 to 30,000 per minute); a slow vibrator capable of adjustment from about two thousand periods per minute down to less than one period per second; a cell selector throwing into circuit from one to six cells at will; an eight-button compound coil selector; a pole reverser and a metallic rheostat governing the primary current. This consists of a perpendicular column seven inches in height, wound with German-silver wire of definite resistance, making twenty turns to each inch of column. Attached to it is a registration scale to denote every wind of wire from zero to 140, and permit a record of position in every degree of use. This scale is also an advance in accuracy of record, first suggested by me. But the peculiar novelty introduced in this apparatus is the author's secondary circuit rheostat, which consists of the glass tubes seen at the left of the switch-board and marked respectively 1 and 2. They contain prepared fluids of great resistance (much greater than water), and are the first competent controllers successfully applied to the secondary current of a medical induction battery. The capacity of the first (one megohm) is sufficient to control the full coil, high-tension current, and reduce the perception of it to zero in the most delicate external applications to a patient.

The second tube possesses a much lower resistance, for currents of less penetrative force. Each tube is scaled in ohms of their actual resistance, measured and calibrated for me by Professor F. B. Crocker, of Columbia College, New York. The rationale of my method is now extremely simple. The fluids in one or both tubes, and at certain heights of the movable contact rod, varying with the primary E. M. F. and current density, entirely nullify the patient's perception of the activity of the induced currents, *i.e.*, control them, and reduce their physiological and therapeutic manifestation to zero, and afterward regulate them to any strength we desire. What resistance to the energy of any given current does it require to do this? The answer to this question is the solution of faradic dosage.

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The scale referring to tube No. 1 shows the total resistance of its four and a half inches of fluid column to be one megohm. As the movable electrode descends in the tube the resistance lessens until it is only 900, 800, 600, 400, 200 thousand ohms, and so on down to the minimum, when the electrodes of the rheostat are nearest contact. The great resistance of this tube is designed to regulate the higher tension currents of the compound coil, which, in this apparatus, I have caused to be placed invisibly behind the switch-board and fixed in complete overlap upon the primary helix. This coil is immovable and does away with former sledge methods of sliding coils on and off, while it generates at all times the maximum of inductive influence.

Tube No 2 is of much lower resistance, ranging from 55,000 ohms down to a residual resistance of 4,000 ohms, and is suited to the regulation of currents of small voltage from short, coarse coils, or other applications where great tolerance exists, as within the pelvis. An additional turn of a switch also cuts out these secondary rheostats and furnishes all currents direct from the coils, in case this is desired. The metallic rheostat in the primary circuit then regulates the dosage by altering the E. M. F., but this rheostat takes no part in my special method of dose registration.

In my method, in applying a given current strength to a patient, it is simply considered that the energy at first wholly absorbed within the secondary rheostat, when perception of the current is nullified on its passage through the rheostat to the patient, is transferred from the controlling grasp of the rheostat to exert an equivalent energy within the tissues when the descent of the movable rod in the tube reduces resistance proportionate to its descent, and in exact proportion raises the current strength in the part of the circuit between the applied electrodes. In other words, as the restraint of the current falls in the rheostat its released energy rises in the patient, and by measuring the degree of restraint we find the equivalent of the released energy.

"Things which are equal to the same thing are equal to each other," and knowing the graduated resistance in electrical units of ohms interposed and removed from the secondary circuit at will, our knowledge of Ohm's law substantially defines for us the values of therapeutic dosage. We have only to let a portion of the measured rheostat substitute itself for the patient's tissues while we at first test the degree of energy to employ, and next to pass on the same current value to the patient, to arrive at a very practical measure of the dose administered. The resistance of the body is compensated in the process and causes no error, and the battery E. M. F. is unaltered during the dose regulation.

Before describing further the details of my method, it is proper to cite the authority for the electrical measurements which constitute the scientific basis of accuracy claimed by me above.

"NEW YORK, December 17, 1894.

"DR. S. H. MONELL. DEAR SIR: I return herewith the two tubes containing liquid resistances which you submitted to me. I have calibrated each tube and provided it with a scale which shows its electrical resistance in ohms for every position of the movable electrode. My opinion in regard to these devices is as follows: 1. A liquid resistance is a very simple and convenient means of obtaining very high resistance for medical use. 2. By changing the liquid the range of resistance may be varied from several megohms to a fraction of an ohm. 3. The screw adjustment of the electrode enables the resistance to be gradually varied to any value, without the sudden shock which occurs when resistance coils are cut out. 4. The resistance is non-inductive, hence there is no reaction against or distortion of the current, which is very important in connection with induction (faradic) coils. 5. A short circuit cannot occur, the electrodes being arranged so that it is impossible for them to come in contact, whereas there is serious danger of short circuit in resistance coils with high-tension currents. 6. The resistance is practically definite and constant, provided the temperature remains nearly the same. With the small currents ordinarily used the heating effect is small, but if necessary the temperature can be tested by a small thermometer and kept constant or allowed for. 7. The effects of polarization and electrolysis are insignificant, since the potential is high and the current is alternating in the case of induction-coils, with which these resistances are to be used. 8. The liquid does not appear to be affected by the action, or to change in any way, but it is of course impossible without actual trial to tell what effect might occur in a long period of time. Any difficulty of this kind might be overcome by renewing the liquid occasionally.

"Yours truly,

"F. B. CROCKER.

"*Professor of Electrical Engineering, Columbia College.*"

While therefore the once proposed scale of fractions of inches was a purely fictitious and ridiculous travesty upon scientific dose-measurement, the author's method is a comparative record of the current strength and not a mere fragment of a tailor's yard-stick. As such a resistance register and rheostat is of general applicability, and may be placed by all instrument-makers upon high-grade batteries and properly standardized for clinical use, it may be fairly claimed that the general adoption of my method would supply the long-expressed need for precision in faradic dose records.

To illustrate the method let us hold, for example, two ordinary electrodes in the hands, select for our coil one thousand five hundred yards of No. 36 wire, and employ very slow interruptions of, say, seventy per minute. We raise the rod in tube 1 to its full height and switch four cells into circuit. Gradually lowering the contact rod, we note the point where the current becomes first perceptible to sensation. It is at 700,000 ohms resistance on the scale. Taking this as our zero unit, we continue to lower the rod until muscular contractions are produced as strong as we desire. The rheostat now indicates but 100,000 ohms, showing that 600,000 ohms of resistance have been removed from the passage of the current into our arm muscles, which feel and respond to the force previously expended within the rheostat. If now I record the facts: Coil, 1,500 yards of No. 36 wire. Interruptions, 70. E. M. F., four cells. Dose, 100,000 ohms, small sponge electrodes in hands, positive in right: I can repeat the exact application and muscular effect whenever and as often as wished, even should the cells deteriorate by use so as to require five or six cells to equal the energy recorded. There is no parallel to this precision of record to be found in the literature of faradic electricity. The method allows for all possible variations in treatment.

Again, using a short, coarse coil, one hundred and fifty-four yards of No. 21 wire, for instance, we obtain sensation with a given contract at 36,000 ohms resistance of tube 2; and full tolerance is reached when but 4,000 ohms remain. The given dose is therefore the electrical energy represented in overcoming 32,000 ohms of resistance with the curren quantity value indicated by the capacity of the wire in the induction-coil. It is not essential to know the galvanic amperage of different sizes of wire with a corresponding voltage, for we are not dealing with galvanic but with induced currents, in which volume is subordinate to potential and kinetic energy; and our different coils —long, medium, short, fine and coarse—take on a definite individual identity under habitual use which serves the expert as a practical expression of their quantity values. Our second record reads with electrodes same as before, but a more rapid rate: Coil, 154 yards No. 21: frequency, 300; cells, two; dose, 32,000 ohms.

In the last case the lower voltage is seen to be commensurate with the greater volume conducted by the coarse wire, while the previous high voltage of the long fine-wire current was proportioned to the extremely diminished volume induced through it.

In making a vaginal bipolar application with a very rapidly interrupted high-tension sedative current we use tube 2, with its low resistance, owing to the enormous tolerance of the tissues treated.

An illustrative clinical record reads as follows: Vag. bipolar sedation, coil 1500, No. 36. Rapid vibrator, E. M. F. 4 cells. Dose, 45,000 ohms, twenty minutes, daily.

If this seems to express small dose (an inadequate estimate of the great tolerance of the pelvic tissues), it must be remembered that it is the difference between zero sensation and the maximum current strength administered with electrodes applied

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in actual treatment, which is recorded as the dose, and not the difference between the sensitive nerve-filaments of the hand and tissues whose dullness of sensation and low resistance to current diffusion permits them to accept with comfort and benefit an application which would be painful on the surface of the skin. If the dose was reckoned from a zero obtained in one arbitrary manner, say, by touching the electrodes with the finger or thumb before applying them to the patient, it would bear no genuine relation to the dosage of larger contact areas, of different varieties of electrodes and different parts of the body.

To be a scientific and universal method it must answer for all conditions of treatment, and my method does this perfectly. The use of a single cell, or of any number up to six (the battery contains six cells), will determine the zero at a higher or lower point on the scale, and the same cells, as they deteriorate, in time will alter their E. M. F.; but these varations do not alter the accuracy of my dose record, which is the difference between the minimum and maximum rheostat readings independent of the number of cells it takes to furnish the given inductive force.

The difference, also, in power to penetrate tissue resistance will create a different zero point for each length and size of wire, even with the same E. M. F. inducing force and same electrodes; but with standard coils, a standard method of finding the actual zero point in all cases, with any coil, with any number of the battery cells at any period of their life, my method furnishes a flexible, permanent, and accurate measurement of the true therapeutic dose. Its adaptability to varying conditions of current volume, voltage, resistance, and density removes all sources of error.

This method, carried out in its fullest detail, is particularly applicable to the records of clinicians and other observers whose investigations require an exact comparison of results. In general practice the physician will soon familiarize himself, at least approximately, with the position of the rheostat for various zero readings, just as the skilled book-keeper soon remembers the ledger pages of his accounts; so that actual tests for zero will be unnecessary except, perhaps, in the first treatment of a new case. If the full dose record is considered superfluous for the physician's own records in his ordinary office work, a modification will furnish satisfactory notes for personal reference. In using the modified method which I suggest, we need not repeatedly calculate the actual dose administered, but simply note the conditions under which the maximum current was applied by recording the lowest reading of the scale. For example: Coil, 1,000, No. 36. Rapid V.; cells 5; scale 6,000; tube 2; vag. bipolar, 20 minutes. There is no expert electro-therapeutist equipped with similar apparatus who, on reading this record, could not instantly apply the same treatment with the same dose, though he were a thousand miles away. The use of initials for full words will, of course, abbreviate the record in our private case-books and be equally intelligible to our understanding.

My resistance scales, therefore, clearly supply to induced currents a dose indicator as practical in their case as the milliametre is in the case of direct currents, and complete the hitherto imperfect record of faradic administration. Of the other factors requiring report for purposes of uniformity in clinical observations, the character of the electrodes can always be identified by sizes, numbers, or names, as in makers' catalogues. Quantity and quality, the elements of induced currents subordinate to their energy and pressure force, are, as we have seen, sufficiently expressed by reference to the particular coil employed. A more exact description will hardly be required by experts in electro-therapy. As the trained electrician becomes accustomed to the quantitative and qualitative differences in effect between every coil in his apparatus, whether 500, 1,000 or 1,500 yards of No. 36 wire, or 800 or 500 yards of No. 32 wire, down to shorter coils of No. 21 or 18 size, he accurately knows the characteristics of currents from them all, and utilizes their diverse properties with intelligence and precision.

It would add no therapeutic value to his knowledge if the current volume, per wire, was noted by a meter in terms of amperage, or the E. M. F. in volts.

There now remains but one factor of dosage still surrounded by vagueness and lack of precision in theory, although clearly defined enough for practical purposes. This relates to the record of the rate of current interruption, a very important part of the matter indeed. Very low ratio (50 to 300) can, however, be stated in comparative figures, while very rapid interruption does not require a numerical term to express its frequency. Speed, as stated in mere figures per minute, is so involved with other qualities of adjustment, evenness, constancy, length of period, etc., that the advantage of a mathematical record can be greatly overestimated.

I have referred to this in other of my writings and it is out of place to dwell on this point at present, though it is one of peculiar interest. A closely related feature, however, may claim our attention briefly.

It is the ideal of some who have sought to define faradic by rate of interruption, and who have devoted much time and special thought to the improvement of faradic apparatus, to construct an independent interrupter, actuated by a current separate from that which supplies the inducing force.

The reason for this lies in the fact that every change in the regulation of current strength made in the primary circuit varies the rate and force of the interrupter in instruments as generally made. A prominent writer has ably argued the advantages of such a method, and states that it can be adapted to every kind of contact-breaker, the motor power for the rheotome being furnished by a single separate cell. The importance of steadfast E. M. F. and unvarying evenness of interruption throughout all graduations of the induced current strength, is so great, so essential to the satisfactory employment of faradic electricity, that no battery not providing for independent secondary current control can be considered as representing the advanced progress of to-day.

Manufacturers of medical batteries, however, do not all agree with the writer who advocates the separate cell for the interrupter, and are well-nigh unanimous in declaring that the mechanical obstacles to the device are insurmountable in practice. The theory is correct, but makers have failed to apply it successfully to the spring vibrators in common use. My apparatus easily surmounts the difficulty; furnishing not alone one cell to actuate the break-piece, but places six at our disposal at will, as independently as any theorist could desire. My former article describing the improved induction apparatus designed by me, referred to this feature at some length, but I wish to emphasize again the far-reaching importance of the secondary rheostats which accomplish this purpose in my battery, and to state further that, were their usefulness and influence restricted to mere regulation of induced current strength, without jarring or irregularity, or change in the primary flow, the advantage they would thus contribute to clinical handling of both patient and battery would alone stamp this apparatus as without an equal in therapeutic convenience and capabilities. That beyond this these rheostats make possible a practical dose record, is proof of their fundamental necessity to a perfect instrument. If still unconvinced that they are indispensable, let us attempt to adjust a slowly interrupted induced current—say fifty periods per minute—to a dosage of strength sufficient to produce powerful but painless, rhythmical, and non-tiring contractions of certain arm muscles, with a gradual and even decrease to scarcely perceptible sensation. With the ordinary interrupter, sliding coil, or primary rheostat, it cannot be done, even with the costliest appliance in the market. With my apparatus it is done instantly and with the most striking success. As an object-lesson in the inadequacy of old methods of current regulation, and of the superior efficiency of my secondary rheostats, it leaves nothing open for argument. Professor Crocket's letter appreciatively sums up the rest.

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ELECTRICITY IN THE TREATMENT OF CHOREA.

Dr. A. D. Rockwell in an article on the Treatment of Chorea which appeared in the Journal of the American Medical Association, December 21, 1895, makes the following remarks anent the employment of electricity in this disease:

"Although I have from time to time tested nearly all the well-recognized remedies in the treatment of chorea, yet there is one remedy that I have used with more or less persistency in almost every case, and that is electricity. I am not so credulous as to suppose it to be curative or even markedly beneficial in any case. Occasionally, on the contrary, it has seemed to be contra-indicated, although long experience inclines me to the belief that this seeming susceptibility to the current is due more to a failure to correctly differentiate in the selection of the kind of electricity used than to any adverse idiosyncrasy present.

In the light of my own personal experience in the treatment of chorea, the opinion expressed more than a quarter of a century ago by a distinguished physician is of much interest. 'Electricity,' he says, 'is another agent which requires a passing mention in this place, though all that can be said respecting it is, that as yet there appears to be little or no reason for placing any confidence in it as a means of treatment. Whether this will always be the case, whether there are not modes of using electricity which will have the effect of quieting choreic and analogous movements, remains to be seen. I suspect that there are such modes, and that they will be beneficial, but I have not yet the facts to justify the expression of a belief on the subject.'

Electricity benefits chorea on the same principle that it benefits neurasthenia or hysteria and many other functional nervous diseases, because of that indirect improvement in nervous force which is a part and a result of the general improvement of nutrition. While electricity is neither life nor nerve force, it aids in sustaining both life and nerve force, as do light and heat; not by direct transformation, but indirectly through its influence over nutrition. This influence over nutrition, together with musculo-sedative effects, are brought about in greater or less degree by various methods of electrization, by general faradization, especially with the high tension coil, central galvanization, static electrification and even by peripheral galvanization. To obtain temporary musculo-sedative effects, there is no method that equals the depolarizing method of central and peripheral galvanization, by which is meant the elimination of either one or the other pole. In this way the neutral point is thrown outside the body, and the part or parts brought under the influence of either the negative or positive pole alone as desired. Static electricity (positive) is also sometimes useful in chorea in calming nervous excitement and as an aid to nutrition.

But the two methods that I have found, on the whole, to be the most effective in the treatment of chorea are central galvanization and general faradization. These two methods properly differentiated and used either alone or in alternation, according to the indications in each individual case, are capable of doing much, not only in alleviating the violence of the choreic movements, but in shortening the duration of the disease.

A somewhat useful point in the way of differential indication for the use of the two currents and the two methods of application, which has been forced upon me by repeated observation, is the following; For children of full habits and in that excellent condition of general health which we not infrequently see among the victims of chorea, the galvanic current is to be preferred. For those, on the contrary, who are weak and anemic with impaired nutrition, the faradic current is far more grateful, and is followed by better results, both immediate and permanent."

ELECTRICITY FROM COAL.

Mr. Edison was asked by a New York reporter the other day, "What invention do you think could be made just now that would be of the greatest possible good to humanity?" "Make electricity from coal" was the reply. And then people wonder why it is that Edison has so great a hold on the people. Science cuts no figure with "the Wizard" unless there is *business* at the end of it.

EARLY TREATMENT OF INSANITY.

Dr. Daniel R. Brower read an article on this subject before the Southern Illinois Medical Association, November 22, 1895, in which he summed up the indications for the early treatment of insanity at home or in general hospitals as follows:

Isolation, rest, somnifacients, gastrointestinal antiseptics, diet, hydrotherapy, electrotherapy, massotherapy and special treatment of abnormal constitutional states.

Under the head of electrotherapy he says: "Electricity, especially galvanism, by reason of its alterative and tonic properties is generally indicated. It is best used first as cephalic galvanization by placing the anode at the forehead and the cathode at the nucha, using large electrodes, with a current strength of three to five milliamperes, for about five minutes; and second, by galvanization of the cervical sympathetic, by placing the cathode over the cervical sympathetic ganglia, and the anode at the nucha and using five to ten milliamperes of current for about five minutes. Static electricity from a machine of high voltage, used as insulation for five to ten minutes, and then as induced sparks, from the spinal region, every day is often very useful."

ELECTRICITY IN BOWEL OBSTRUCTION.

Althaus reports in the British Medical Journal a case in which the patient had suffered for three months with obstinate constipation. At the time of coming under observation the bowels had not moved for ten days, and the abdomen was distended and tender. She had no appetite and a condition of collapse existed, with sunken face and small, feeble pulse. The introduction of the long tube proved unavailing, and electric treatment was resorted to. An insulated sound, with a fine metallic end, was introduced into the rectum, and a moistened conductor applied to the abdominal parietes, chiefly in the region of the sigmoid flexure. Through this circuit a primary faradic current was passed and its force gradually increased until the patient experienced a decided feeling of vibration in the bowel. In the course of the day a copious intestinal evacuation ensued with relief of all the symptoms. During the next two days the bowels acted ten times, and in the course of a week the patient appeared quite well.

DAKOTA FAIRY TALES.

An esteemed Wisconsin contemporary states in cold blood in its editorial columns that in South Dakota a farmer named Hunter, lights up his entire farm, which includes a section of land, with electricity during harvest time, heats his house and barns, and furnishes motive power for his machinery with it. The water from an artesian well, flowing 3,000 gallons a minute at an enormous pressure, furnishes the power to accomplish this.

UNDER RUNNING TROLLEY CASE AGAIN.

The case of the validity of the "under running trolley" patents has been reopened by Judge Townsend of the United States Court at New Haven. The suit was decided in favor of the Thompson-Houston Electric Company against the Winchester Avenue Railroad Company a few weeks ago. The case is defended by the Westinghouse Electric and Manufacturing Company, for the railroad.

RAILWAY DAMAGE CLAIMS.

The following report from the law department of one of the large Western roads is submitted by the Street Railway Journal as evidence that "good legal advice pays."

"The damages claimed in all the suits brought against the company during the nine years amounted to a total of $1,729,655. Of this claimed amount $1,064,569 was settled out of court for the sum of $39,029. Of the remaining claims, $665,059, judgments were rendered for $44,932, which judgment claims were subsequently settled for $30,559. The total disbursements of the company, therefore, on account of damage suits were $69,588, an average of less than $8,000 per annum."

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THROWING ON A RAILWAY GENERATOR.

Many subordinates in power stations who are striving to climb higher do not know how to properly throw a railway generator on to the line, or to throw it off when the run is ended. Railway generators are usually arranged for connection to the switchboard in one of three ways. Some are provided with a double-pole switch, and the equalisers are permanently connected together. Some have a triple-pole switch and an equaliser bar, while others have three separate switches. These three methods of connection are shown in Figs. 1, 2, and 3, and in each case it is necessary to follow a slightly different method in throwing the machine on the line. In any case the following precautions should be carefully observed: —

A generator must not be thrown on a set of 'bus bars to which several dynamos are supplying current unless the voltage of that generator is equal to that of the 'bus bars. A large generator when thrown into multiple with a small generator will operate the latter as a motor unless the larger generator has a slightly lower voltage. If several small generators are connected on the line, and their combined capacity is greater than that of the large one, this precaution need not be observed. It should be remembered that when there are two machines the bus-bar voltage is always that of the generator of the greater capacity. Therefore this should not be high enough to overpower the smaller machine. It is wise to have the voltage slightly lower at the time the machine is thrown in.

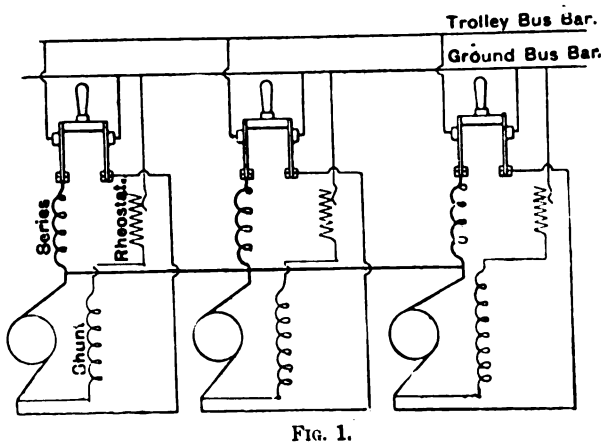

FIG. 1.

The method of procedure in case of Fig. 1 is as follows: With the brushes raised start the generator, being sure that the oiling devices are working properly. When full speed has been attained, see that all switches are open and then let down the brushes, being careful to adjust them so that they run without cutting or "squealing." Then step to the switchboard. Throw in the equalizer switch if there is one, and give the rheostat a turn, and let the machine build up. While the machine is building up consult the ammeter, which gives the total load on the station, and then make some such calculation as this: "I have at present a total load of 800 amperes. When this new machine is thrown in the combined capacity of all the machines running will be 1,200 amperes. Therefore eight-twelfths of the capacity of the machine is the load it should carry.

The capacity of the machine is 250 amperes; $\frac{8}{12}$ths of 250 is 167 amperes approximately. This, then, is the load which the generator should carry. Probably before this calculation is finished the machine is ready to be thrown in. Bearing in mind the precautions already mentioned, bring the voltage of the machine up to the proper amount. Proceed slowly. It takes time for a machine to regulate. After the desired voltage has been reached, and shows no tendency to change, throw in the double-pole switch. Attention should at once be directed to the ammeter. By means of the rheostat adjust the current to 167 amperes, in accordance with the previous calculation. It will be found that the instrument will now readily respond to the motions of the rheostat, while the voltage depends on the voltage of all the machines, and therefore has passed out of control.

With the three-throw switch the procedure is exactly the same, only the equalizer is thrown simultaneously with the other terminals.

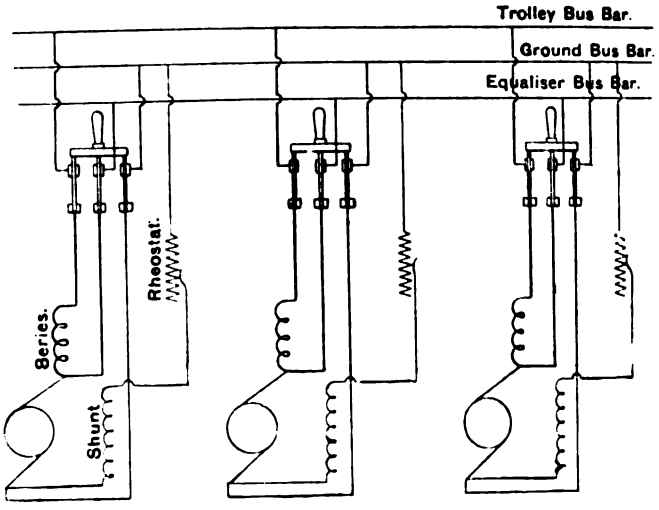

FIG. 2.

With the three separate switches the controller is a little more convenient. The equalizer should be thrown first, and then the switch on the positive side. All coils and instruments are by common custom placed on the outgoing wire, hence the series coils are thrown in multiple with the series coils of other machines, and are receiving a current which provides an initial excitation for the field-magnet. This prevents annoying refusals of the machine to build. After the machine has acquired the proper voltage, throw the positive switch, observing the same precautions as in the other cases.

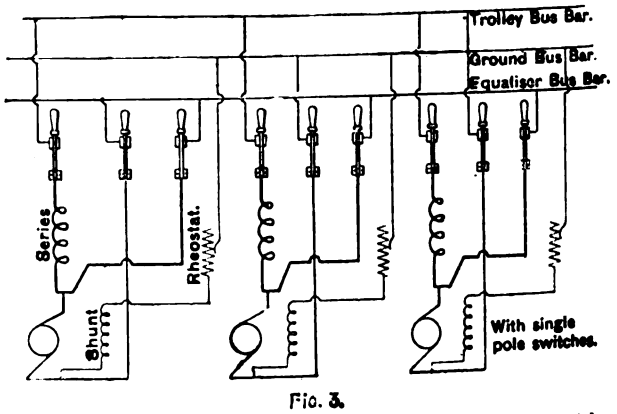

FIG. 3.

To shut down a machine at the end of a run, stand with one hand on the main switch, and give the rheostat a slight turn, which will tend to weaken the field. The load will gradually come off the machine as will be shown by the ammeter. Watch the instrument, and when the reading denotes about one-fourth load, throw the main switch at once. This permits the load to be gradually thrown off, and the danger of racing and wrenches to both dynamo and engine are avoided.—*Electrical Railway Gazette.*

AMERICAN MACHINIST IN NEW DRESS.

The *American Machinist* appears, beginning January 2d, reduced from blanket size to 9x12 inches. It has also changed the color of its dress to sage green. It is now the size of THE ELECTRICAL JOURNAL, not very far from the same color, and is one of the best mechanical periodicals in the country. It has added an electrical department to its reading columns. We welcome its improvements and approve of the recent changes.

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CABLE LAYING IN THE TROPICS.

The Electrical Engineer, (London), tells an interesting story of a cable repairing trip in the tropics. As a relief from the "signs and omens" usually going into the composition of a technical journal, we give the story.

"As the events I am about to relate took place in comparatively recent years, and most of the persons concerned are still living, I think it advisable, in the interest of those persons, to avoid unnecessary candor in the matter of names and localities. "Peace on earth and good will unto men."

The good ship 'Express' had been beating her bows deep into southern seas for some months, robbing the bed of the sea of some of its wonderful carpeting and putting down in its place various lengths of brand-new cable, when orders were received to proceed at once to the coast of Bulamaroo to repair a total break which had occurred in the section between Caramba and Matahomo. To have to go to Bulamaroo at all was a misfortune. To make Caramba—a mixture of Muscat and Old Calabar—our headquarters, fell nothing short of a dire calamity. It was not the youngsters. They would have sailed for Guam with Jonah as a shipmate. It was parties with nerves—mainly the skipper.

Taking it generally, it was hard lines. The 'Express' was a crack ship, commanded by a high-toned but nevertheless capable seaman. She—and he—had been accustomed to sail in civilized waters, and in the intervals between grappling with minor difficulties to be feted and made much of by good society. The prospect of fever—when one has nerves—serves but to irritate, and the certainty of exchanging My Lords' graceful condescension for the offensive familiarity of a greasy negro population had little in it to soothe. However, we went.

It was, if I remember rightly, on the sixth day out, that the Old Man took sick. On the twelfth there was no more champagne. At 11 o'clock that night I was on the upper bridge, tramping it for company with the officer of the watch, when a ghostly figure, clad in a long white garment, made its appearance at the telegraph, and signalling 'full speed astern' to the engine-room, shouted out 'Breakers ahead.'

It was the skipper, and he asserted that he could smell the land.

Poor old chap. Now, I have nothing but pity for him—a gentleman, a first class seaman, and, as a rule, a very abstemious man. It was due to an unfortunate and perhaps constitutional dread of fever that for the first and, I believe, the last time in his life he drank to excess. At that juncture, however, it seemed far more serious. We were upon an important mission, the latitude was one of frightful storms, and the thought that our lives were under the care of a man who smelt "breakers" when there were 700 fathoms of water beneath us and no land nearer than 500 miles was far from comforting. Eventually we got him to bed.

Arrived at Caramba, we proceeded to land our apparatus and take the necessary tests. The skipper was moderately sober but touchy. He intimated that he should consider it his duty to leave within 24 hours, whether we had located the fault or not, and declined to argue. Fortunately, the cable was brass-taped, and had been crushed flat so that it gave a dead earth, and the tests were simple and conclusive. We located a break 20 miles to the southward, and requested the skipper officially to take the ship to the spot indicated and place a mark buoy. For an hour or so we were busy with our preparations in the testing-room, and then my chief left to inspect the picking-up gear and the fore tank. It was at that moment that things became really lively. We were, it appears, steaming due north instead of due south, and when the skipper was remonstrated with he threw things—chiefly paper-weights—and used language equally hurtful. To put him under restraint was dangerously like mutiny on the high seas, but it had to be done, and with the chief officer in charge we again put into Caramba and telegraphed for instructions. What those instructions were I need not say, but the skipper never again resumed command.

The loss of so experienced a man as Captain —— naturally made our work more difficult. My chief had to take charge of the deck, while I looked after the electrical arrangements and assisted in checking sights, etc. Not only was our chart wrong and the cable nine miles to the westward of the position laid down, but a submarine landslip had made 500 fathoms difference in the soundings, and, in short, we were all at sea. Of course, we found the cable at last—after breaking the toes off five grapnels—and then had to tear it out of a third of a mile of rock which lay on top of it, repeating the operation some two miles farther south. For 36 or more hours we had not a scrap of food, a heavy ground swell made the ship roll her scuppers under water, and when, at five o'clock in the afternoon, we finished the final splice, and stood by it to cut away and cheer, somebody said, 'Good Lord, it's round the forestay!'

So it was.

It was in the nature of things as they happened that voyage that the skipper should turn up at the moment and witness our discomfiture.

If ever a crew were in a blue funk, the crew of the 'Express' could have gone one better. To unship a forestay with the ship laboring heavily is an experience. Every moment the foremast threatened to come by the board, but it did not, and by seven o'clock the final splice was safely slipped, and by half-past ten we knew that the repair had been successful. Our homeward trip was equally prolific of incident, but that is 'another story.'

MUNICIPAL SERVICE IN TROY.

The Electric Light Commission met last night and adopted a a rate for incandescent users, says the Troy Times, Jan 8th. With the new schedule the electric light is within the reach of all, and it looks as if the capacity of the light machine will be taxed to its utmost in a short time. The list as adopted follows: Saloons, first light $5, subsequent lamps $2.50; stores and residences, first light $3, subsequent $1.50; churches, $1 a year for each light installed; barbers' shops, $3 first light and $1.50 for each subsequent light; public halls, laundries, factories and mills, special rates; light in hallway of residence, $3 a year; barns and sheds, $2 a year; cellars, $1; sleeping rooms and bath rooms, $1.50. The rules and regulations which will govern the incandescent service, and which were adopted last night, are: All wiring and lamps to be put in at the expense of the taker; bills to be rendered quarterly in advance on the first days of March, June, September and December, and must be settled within thirty days or the light will be cut out without notice. In case of deficiency of light notice should be given at once, that the defect may be remedied. The commission reserves the right to turn out the light in case of arrearage or violation of the rules; rates are based upon sixteen-candle-power lamps and are to be increased or decreased proportionately as the power of the lamps is increased or decreased. All light and wiring to be subject to inspection by the commission. Any room divided by an archway will be considered two rooms, and light will be based accordingly. The new schedule went into effect December 1, and George A. Van Bergen, the new collector, will appear this week to receive the first quarter's rent in advance. A committee will wait upon the officials of the Delaware and Hudson Canal Company later in the week relative to lighting the bridge and freight house.

Mankato, Minnesota, sent out more than three weeks ago a resolution passed by its city council to receive bids for the construction of an electric railway and light plant for the city, to twenty leading electrical contractors and to the trade journals; but so far, no bid has been received, and the people of Mankato must still use the festive horse-car and the joyous kerosene lamp.

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ELECTRICITY IN WAR.

The recent war talk has directed attention to the utilization of electricity in naval and military warfare. Electricity is now of the greatest value in the operation of the army, more particularly in the form of the telegraph, the field telephone and the war balloon, and in men-of-war it has come to be indispensable in ammunition-hoisting, range-finding, and the handling and firing of big guns, and torpedo work. In the last named field a new invention has been announced, styled the "electric fuse train." Its declared object is to "effectually retain the force of exploding gun-powder, so that none of it is lost, and to direct its force at any desired point." The fuse train is said "to burn with a sudden and irresistible flash, the flame and explosion traveling with so great a velocity that it can never be put out by the pressure of water when submerged; and when the flame reaches the torpedo, shell, mine, etc., to which the device is attached, the coil of fuse train, flashing off, fills the powder chamber instantly with an intensely hot, confined flame that penetrates the powder and causes every grain to explode at the same instant." How this is to be done is not explained, but the limited details of the invention which have so far been made public seem to point to the production by electricity of the flash which is simultaneously to pervade every part of the powder chamber. It is stated further that this fuse train is perfectly reliable, and excels every other means of communicating fire to one or more charges of powder, torpedoes, shells, mines, blasts, etc., either near together or distant from each other—one line of the fuse train only being required for any number of explosions.—*Chicago Record.*

SYSTEM OF ELECTRO-THERAPEUTICS.

"BIGELOW."

In the work carried on by the National School of Electricity in its electro-therapeutic classes throughout the United States, the paucity of the literature upon this subject has been painfully apparent. On this account and in response to many enquiries from physicians regarding text-books worthy of recommendation, THE ELECTRICAL JOURNAL has decided to notice in its columns the works upon general and special electro-therapeutics which seem to meet this demand. Among these few books is the International System of Electro-Therapeutics which, although it appeared more than a year ago, is by reason of its breadth of scope and the thoroughness with which the various subjects are discussed, worthy of principal mention. The work is encyclopedic in character, and while there is necessarily something of unevenness on account of the holy-editorship, still as a whole it is perhaps more complete than any book on the subject with which we are acquainted.

The editor showed wise foresight in entrusting the introductory article to Professor Herdman who makes a masterly appeal for special education in electro-therapeutics. He very properly discourages the study of electro-therapeutics unless prefaced by a thorough knowledge of electro-physics and electro-physiology and urges that the student should first be taught the practical points that are likely to arise in the use of machines for generating electricity for medical purposes. To this end he should construct his own apparatus, for generating electrical currents and applying them to the body. This preparatory work is indispensable to the student. He should next take up the study, in the laboratory, of the manner in which the various living tissues in animals and man respond to the electric stimulus, as this training will prepare him for the final or therapeutic course and enable him to guard against innumerable blunders and will arm him with that confidence in the agent he is employing which is a necessity to success.

We have dealt this at length with the introducton, because it so well expresses the spirit of the whole work. The space allotted to this notice will not permit of an extended mention of the various sections of the book, but especially noteworthy are the chapters on Diseases of the Lungs and Heart, by Dr. N. S. Davis, Jr.; on Diseases of the Uterus, by Dr. G. Betton Massey; on Discussion of the Electro-Therapeutic Methods of Apostoli and others, by Dr. J. H. Kellogg; on the Treatment of Diseases of the Uterine Appendages, by Dr. Augustin H. Goelet; on Disorders of Menstruations, by Dr. A. Lapthorn Smith; on Treatment of Diseases of the Female Urethra, by Dr. Franklin H. Martin; on Electricity in Diseases of the Skin, by the late Dr. Peym. S. Hayes; Diseases of the Brain by Dr. C. Eugene Riggs; Neuroses, by Dr. Morton Prince; Diseases of the Spinal Cord, by Dr. William J. Morton, and on Treatment of Strictures, by Electrolysis, and Hypertrophy of the Prostate, by Dr. Robert Newman.

These men and the others who have contributed monographs, are a guarantee of the practical nature, of the work throughout. They are all high up in the councils of the profession in their respective fields of activity, and their determination as to the scope of this agent. Electricity will be received as authority.

We do not altogether follow some of the more sanguine and enthusiastic of the contributors in all their statements, and would perhaps be inclined to take them to task on some points, did we not feel that enthusiasm is a necessary qualification for advanced and successful research work. There is hardly a question that some of the thinkers and workers in the profession, who are giving attention to electricity will take issue with some of these contributors at an early day, and the event will turn to the good account of the art of healing.

Taken as a whole, the work is one of the best treatises that has been issued on this subject, and is certainly to be regarded as the most complete in existence.

AN INTERNATIONAL SYSTEM OF ELECTRO-THERAPEUTICS.—For Students, General Practitioners and Specialists. By Horatio R. Bigelow, M. D., Fellow of the American Electro-Therapeutic Association, etc., etc., and Thirty-eight Associate Editors. Illustrated. In one large royal octavo volume, 1,160 pages; extra cloth, $6.00 net. May be purchased through THE ELECTRICAL JOURNAL.

MOTOR VEHICLES IN ENGLAND.

In England they have gone most seriously into the business of manufacturing and selling the motor vehicle. At a meeting recently held in London, an association was formed to be called the Self-Propelled Traffic Association, to be incorporated under the Companies Act. Sir David Salomons, who presided, stated that the Association had for its objects the encouragement of a new industry in England, "and the conferring of benefits upon the agricultural classes and the struggling professional man." The benefit to the agricultural classes is to be the adoption of the horseless vehicle in place of light railways in bringing garden produce to the distributing centres; the benefit to the struggling professional man was not particularly specified. It is proposed to limit the liabilities of members to the amount of their £1 shares. Mr. A. J. Lawson, "the inventor of the bicycle," described how he and his friends had secured the continent, buying up patent rights in connection with the manufacture of the horseless carriage at an expenditure of £100,000, which he urged as evidence that no stone would be left unturned to secure success for the new industry.

NEW YORK ELECTRICAL EXPOSITION.

Mr. Clarence E. Stump has been appointed general manager to the Electrical Exposition which is to be held in New York City, commencing May 4, and continuing until the first of June.

Numerous inquiries for information regarding space and other details are daily being received by the management, and a large number of prominent manufacturers have already closed contracts, while many additional firms have signified their intention to make extensive exhibits. The success of the enterprise is assured, and all indications point to the largest and most interesting display of electrical apparatus and supplies ever made in this country.

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STATE CONTROL OF POSTS AND TELEGRAPHS.

Excellent Results Obtained in Norway from Control by a Standing Parliamentary Committee.

There is an institution in connection with the post-office in Norway which might be copied in this country with advantage. The British system is to have a postmaster-general who, previous to his appointment, has had no experience of postal, telegraphic or telephonic business, and who, nevertheless, is supposed to be responsible to the country for the conduct of the great department of which he is the nominal head. Such an official, however experienced he may be in general matters, necessarily falls under the influence of the permanent officials of the post-office, whom he naturally regards as best qualified by special training and long experience to guide him in matters appertaining to the department. This course would be a logical one were it not for the fact that the postmaster-general is appointed for the very purpose of controlling the permanent officials, and not for being controlled by them. The very *raison d'etre* of such a functionary is the necessity recognized by parliament of imposing some restrictions on the permanent officials, and the intention of parliament is violated by the practical outcome of the present system, which has not infrequently degraded the House of Commons into an arena in which the postmaster-general of the day has aired his ignorance of matters about which he was technically responsible to the nation.

They manage these things better in Norway. There the posts and telegraphs and such railways as belong to the state are under the immediate control of a standing parliamentary committee consisting of nine members, which committee has power over expenditure and over contracts, and without its consent no modifications of existing regulations may come into force. The postmaster-general and the directors of the telegraph and railway departments report to the minister of public works when parliament is not sitting, but during the session they report direct to the house. But in any case their reports are referred to the parliamentary committee, and are digested by it before coming under the consideration of parliament as a whole. This arrangement is found to work remarkably well, because the committee is made up of members of parliament who come from all parts of Norway and are acquainted with the needs of their several districts. Local requirements are not, therefore, neglected, as with us they are so apt to be, but receive careful consideration. As the members of the standing committee usually remain on it for several years (as in the event of the dissolution of parliament a proportion of them always returns to the new house) the committee becomes well acquainted with postal, telegraphic and railway affairs, and constitutes a direct representation at these important state departments of the commercial interests of the country. Members of the committee do not receive any salaries in return for their services.

Such a standing committee of the British House of Commons would be well calculated to put so much life into our posts and telegraphs department as would at least prevent reforms from being shelved indefinitely, or from only being adopted after the permanent officials have, so to speak, died in the last ditch in fighting against them. The responsibility to parliament, which is now merely nominal, would then become actual and real, and the author is much mistaken if such a committee would not find a very large field for useful explorations into the operations and methods of administration of the post-office, which would not then, as now, be the master of the public instead of its servant.—*British Exchange.*

NIAGARA WATER POWER.

Secretary Rankine announces that a contract has been executed between the Niagara Falls Power Company and Walton Ferguson, of New York City. A manufactory will immediately be started for the production of chlorate of potash on the lands of the Niagara Falls Power Company. The site of the location is about 200 feet east of the site of the Carbide Manufacturing Company on the line of the Niagara Junction Railway and covers one acre. Buildings are to be erected at once and a block of 500 E H. P. will be the first delivery. The contract provides for additional amounts of land to be taken within the next year, with power aggregating 3,500 E. H. P.

ELECTRIC WELDING.

A system of electric welding, says the Detroit Free Press, is finding favor in England which differs considerably from the Thomson and Bernardos processes, which are now well known. It is called the Zerener system, and depends on the deflection of an electric arc by a magnet. If a strong electro-magnet is placed beside an arc playing between two carbon poles inclined to each other, the arc is driven outward until it resembles a blow-pipe flame, except that the temperature is enormously higher. The apparatus is made in two sizes. The smaller is designed for use by a single workman, and in it the carbons are fed together by a small thumb spring. With one of these machines driven by an engine of five horse-power and a correspondingly small dynamo, one workman made 2,000 brazes in fifty-four hours, including brazing the seams of ornamental metal cornices and the joints of bicycle frames. The apparatus seems to be quite successful in bicycle manufacturing, and two complete plants for this work are now in use. The larger machine is so heavy that it has to be suspended, and the current used in it varies between 150 and 300 amperes. Steel pipes from one-eighth to one-half an inch thick have been longitudinally welded, and the rate at which the work was done is said to compare favorably with that of riveting. Ship deck plates up to five-eighths of an inch in thickness have been welded satisfactorily, and a plant for this particular work is now being erected. All the seams in a steel barrel of forty-eight gallons capacity can be finished in an hour with this machine, using about eighteen horse-power to run the dynamo, and two barrel plants of this type have been erected recently.

VOMITING IN PREGNANCY.

Bonnefin (Journal de Medicine de Paris) reports an interesting case of persistent vomiting which resisted all other treatment, and was subdued by thirty-one daily electrizations of the pneumogastric nerve, applied immediately after each meal, at the time when the food or drink was usually vomited. The duration of the faradization varied between two hours and ten to twelve minutes. Food could be retained and digested only while the current was being applied. The vomiting ceased at the end of a month's treatment, but the patient had an irregular appetite, despite a residence in the country, yet was gradually regaining her strength. The case was one in which hysteria played a considerable part.

The method of applying the electricity was as follows: Immediately after the ingestion of food, as soon as the nausea began the author applied a moist electrode of an induction current to the neck, over the line of the pneumogastric. This was maintained in position until the food was digested or until the nausea disappeared. The points of selection for the application of the electrodes are situated above the clavicle, in the space between the sternoclavicular muscles. One may be placed on the neck at this point, on the right side, while the other is placed over the epigastrium.

The Portland, Ore., General Electric Company has acquired control of the Union Power Company's establishment, the plant in which consists of seven machines of 200-horse power each. The company is now supplying power for all the street railways in the city, with the exception of what the City & Suburban company furnishes its East Side lines from its power station near Inman & Poulsen's mills.

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

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Meter Measurement in Medicine.

In another column we publish a paper by Dr. Monell, of New York, on the subject of alternate current dosage, with a description of a new method of determining the same. Dr. Monell correctly premises the real subject of his paper with the statement that from the standpoint of the operator, it is not necessary to measure the alternating current and that the only need of so doing is for purposes of record in reporting results. In our next issue we shall take the liberty of differing from Dr. Monell as to some of his results, especially with regard to the completeness of his new instrument. Before we had read Dr. Monell's paper we had determined to discuss the absolute necessity to measure always the amount of current administered of the direct or galvanic variety. Dr. Monell's remarks on this point entirely coincide with our own view.

We have been asked repeatedly within the past few weeks by physicians whether it is necessary to use measuring instruments when applying electricity to the human body for remedial purposes And if so, what instruments they should use. One of the physicians suggested that he could measure the current accurately enough for all practical purposes by his sense of touch, but that he supposed he ought to have some sort of measuring apparatus so that in case of an accident he would be protected against damage by suit for malpractice.

While this latter point is sufficient to keep some physicians in hot water throughout their professional lives—electricity or no electricity—there are other considerations of far greater import, the one great consideration of all being the successful application of a powerful agent in doses prescribed by those who have studied the pathology of the case and the action of the current intended for its treatment. What careful physician would undertake to measure out the alkaloids, for instance, on the point of a pocket knife even if they carried their drugs as in the old days? Not less important is it to measure an agent whose action depends as much on its quantity as does the action of strychnia.

The case is not so important where the alternating current is used since it is usually prescribed at high pressure and in minute quantity. If we can be assured of an approximate voltage and within reasonable limits of the number of alternations, we need not watch details so very carefully. And with the static charge we must, of course, take a great deal for granted, but there, too, we have every assurance that we are getting a voltage up into the hundreds of thousands and a quantity practically incapable of even a minimum electrolytic action.

With the direct current, however, the case is entirely different. There the action that we strive for depends on the quantity of current paid out, and the physiological action of the direct or galvanic current depends as much on the number of milliamperes as that of calomel depends on the dose we give. For instance we have some delicate work to perform especially where a mucus membrane is to be treated. What intelligent and thoroughly posted surgeon would attempt the treatment of a urethral stricture without the use of a milliamperemeter? We know that a proper current will cause softening and absorption of adventitious tissue and a consequent relief from the trouble, while an increased current will cause burning and all the accompanying distresses that have served to make the treatment unpopular with unskilled operators. The same may also be said of cataphoretic and catalytic action. Emphatically, no physician should attempt to administer the galvanic current without a thoroughly reliable milliamperemeter under his eye—and in the circuit.

But here is the great question—"What instrument shall I buy for this purpose?" And this is the part of the question that is most difficult to answer. The apparatus for administering the current, including batteries and all auxiliaries, will cost from fifty to one hundred dollars. A Weston milliamperemeter costs from sixty to one hundred, and the average physician fails to understand why this great amount for only an instrument to measure with when the whole apparatus costs only the same amount—or if he understands he simply is unwilling to give the amount for it, and he either uses his "sense of touch" or declines to use electricity at all. If the former, then he fails to obtain results, and "electricity is worthless." Instruments may be purchased for far less money, but they do not measure accurately, and none at all is better than a faulty one.

By all means let us have a milliamperemeter at once good and cheap.

* * *

The Outlook For Electro-Therapeutics.

The medical practitioner who has given any thought to the rapidly increasing knowledge concerning electricity, and who has observed the marvelous strides man has made in bringing it into his service must often have the query occur to his mind, "What can it do for me?"

The answer to this question lies in the solution of the other question—What relationship does electricity bear to living animal organism?

For more than two centuries physiologists have been experimenting with such appliances as have been furnished them for generating and controlling electric currents. So far, for the most part, their results have been obtained from currents derived from a few cells of some form of primary battery or from induced currents produced by the Dubois-Reymond coil. Even these simple appliances have been the means of establishing facts of great value to the physician, and the accumulated knowledge which has resulted from such experimentation serves as a foundation for the rational electro-diagnosis and therapeutics of today.

They have shown that in electricity we have an exact and reliable means for determining the state of nerve and muscle nutrition which can be obtained in no other way. They have demonstrated the sedative influence of the anode and of the high tension coil current, and the exciting action of the cathode and of the primary induced current; and these effects can be, and are turned to valuable account in therapeutics. But the physiologist has not kept pace with the physicist and the worker in industrial arts in utilizing the more recent discoveries in the transformations of electric energy and in seeking to determine their relationship to living animal tissues.

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If electric energy of low tension and comparatively small quantity, by steady flow through animal tissues for a certain time, is capable of changing the functional activity of nerves and muscles and of changing the positive and chemical composition of the constituents of their tissues, than currents of a different tension, direct, interrupted or alternating, of which the varieties now made available are almost unlimited, must have a corresponding difference in physiological action. And these differences, when determined, will furnish corresponding therapeutic possibilities.

Already the physiologists have shown us that muscular contraction and many other tissue activities are, in part at least, transformed into electricity. It remains for us to learn from them in what manner the reciprocal transformation of electricity into vital processes can be brought about. Now that electric energy can be furnished to the physiologist under almost any physical condition of tension, quantity of current or direction of current that can be named, no more inviting field of experimentation for him could be offered. The advance of electro-therapeutics into a wider field of application must, to be firmly established, await such investigations.

* * *

Telephone Contracts.

The Circuit Court of Detroit has recently decided that a telephone company is a common carrier and is not therefore entitled to dictate terms upon which it shall serve its patrons. More specifically the decision denies the right of the telephone company to demand a contract covering a stated time before it consents to give service.

We think there were several special conditions at work in this case that will not apply elsewhere. One of these is the fact that the decision comes from Pingreeville. The other is that the telephone company in Michigan, which has been always manipulated by the McMillans, has been in bad odor with the people. We do not believe that the decision will be sustained in the higher courts, or that another such decision will occur.

A telephone company may be a common carrier and perhaps is, and we would never consent to a proposition to allow any such company to decide whether it would serve an applicant or not; no distinction or discrimination should be made. But it is well known that telephone service involves some actual expense. Aside from the royalty rights—which the public is not bound to consider—there is labor and material to supply, and afterward there is the maintenance of a service that represents an actual daily outlay. And before this service can be rendered, elaborate preparations in the shape of central stations must be furnished. In other words the service of every telephone costs money, and has to be provided for. We are not of an anarchistic turn. Hence we believe that capital should be protected. Telephone companies ought by all means to be allowed to demand a contract. But such contract should be reasonable. For instance, we do not believe that an applicant should be made to subscribe for a whole year unless he wishes to do so, but he might, in justice, be made to pay a higher rate, or an amount sufficient to indemnify the company for the material and labor expended on a short time contract, in addition to the regular rate. We can see great injustice in an elaboration of the Detroit decision.

* * *

Acetylene Gas.

We do not feel called upon to defend the parent Acetylene Company from the charges of manipulation that have been recently published, nor to go into the business methods employed in exploiting the new gas. We know that every new thing that promises successful competition will meet with all sorts of difficulties. The time is not yet come, however, when the electrical people or press need resort to mud throwing to gain a point, and we very sincerely believe it will never come. The great success of electricity depends on hard work along correct lines, and an honest concession that for some purposes and under some conditions other elements are preferable.

As for acetylene gas—it seemed to us on examination at the experimental rooms of the Illinois Acetylene Co. in the Rookery a few days since, that it is more brilliant by far than coal gas or even than electricity. Its light is white and clear. It is easily handled compressed down to liquid form and sealed in heavy steel cylinders capable of exerting a resistance of about 3,000 pounds or about six times the pressure of the gas when stored in the tubes. It is contemplated to handle the gas commercially in two ways: 1st, by selling it through sub-companies direct to consumers in cylinders large enough to hold a sufficient quantity to last a month or longer; 2nd, by selling the rights to manufacture the gas to existing gas companies who may mix a small percentage of acetylene with the ordinary coal gas to the great improvement of the candle power.

The desirability of acetylene seems to us to be in the brightness and whiteness of the light, and the comparatively small quantity required to furnish as much light as the ordinary private home will consume.

Its disadvantages are that it is very pungent and offensive when liberated; its present cost, unless extravagant claims are justified is great, and the high pressure it must be kept under in the cylinders will hardly be reassuring to consumers, although it is claimed that ample protection is furnished against explosion by the strength of the cylinder and by a system of valves opening out of doors, where the cylinders are placed.

On the whole we see no reason why the electric light should give way to acetylene.

* * *

British Humor.

The proverbial inability of the average Englishman to see a joke without an accompanying diagram or a surgical operation, is so well known that it no longer excites comment. Occasionally, however, instances of such flagrant stupidity present themselves that one is moved to wonder at the scantiness with which nature has endowed that race with one of her happiest gifts.

We are led thus to cogitate, by the comment of the London Electrical Engineer upon an item which appeared in THE ELECTRICAL JOURNAL in a recent issue. The item referred to was anent the Keeley Motor. It told of an expert who had investigated the Keeley Motor and had reported that "there was no longer any use in our devoting any more time to electricity; that something far better had been found; that it was a costless force, and that the value of the discovery was incalculable," etc. The complaint of our London contemporary is that the item was published without labeling it a "fake" or a "joke," or marking it in some other manner to designate it as improbable and untrue. We can only plead in extenuation that to have so labeled it would have been an insult to the intelligence of our many American readers. We shall hope some day to get out a special English edition of THE ELECTRICAL JOURNAL, when we shall certainly furnish diagrams and specifications with all jokes or items not strictly "*probable* and true."

* * *

Engineer Martin and Electricity.

The Brooklyn Eagle takes offense because THE ELECTRICAL JOURNAL has taken the liberty to advise Mr. C. C. Martin, chief engineer of the Brooklyn Bridge, as to the possibilities of electricity for the propulsion of the passenger cars across the bridge. After suggesting that THE ELECTRICAL JOURNAL doesn't know what it is talking about in presuming upon Mr. Martin's ignorance, the Eagle adds: "Mr. Martin is busy just now. He has done good work in the past. There is no reason for saying that he will not do good work in the future."

That is just what we supposed. Mr. Martin is busy, consequently has not had time to "inform" himself, and unless he differs materially from most Easterners he doesn't know there is anything in the West but prairie and buffalo, hence we have

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taken the liberty to call his attention to some things that have been done out here that he would do well to know. We are glad that Mr. Martin is not opposed to electricity, and that he is going to work in earnest to give the Brooklyn people the best possible bridge service—something they have not now, and never have had.

* * *

The Electro-Magnetic Telegraph.

The Electrical World series of articles on the "Electro-Magnetic Telegraph" has been brought to a close with final brief papers "in rebuttal" by Miss Mary A. Henry, the accomplished daughter of the late Prof. Joseph Henry, Edward Lind Morse, and Stephen Vail. After a careful rèsumè of all the evidence submitted in this remarkable series of papers, we presume to "hand down" a decision as follows: Prof. S. F. B Morse, with the able assistance of Mr. Alfred Vail invented the telegraph, using therein principles mainly discovered by Joseph Henry. Of course there have been many improvements—mostly mechanical—since the days of Morse's crude instrument, but good mechanics are plenty in this inventive age and land. The court finds that Stephen Vail is in contempt of the 'riot act," and must be suppressed. The other attorneys are congratulated by the court on the ability with which they have pleaded their client's cause.

* * *

Does Advertising Pay?

Advertising is a great thing. Those who don't believe it, try for a time to head off the announcement that the "Electrobat" won the Times-Herald Motocycle contest. The Morris-Salom vehicle won the gold medal, but the Duryea gas machine won the $2,000. The Electric Storage Battery Company, whose cells were used, and the Lundell Motor people, whose motor was used, announced in the various advertising mediums that the "Electrobat" won first prize, and no reservations were made. The papers all over Christendom are publishing it that way and the statement is being read by the Kamchatkans and the Hottentots. And still some people don't advertise!

* * *

We Congratulate McKinlock.

Is is not often that we would feel justified in calling attention, in this column, to the enterprise of a purely commercial company, but reference to an item in another column concerning the new Metropolitan catalogue will bear us out in our intention to congratulate the Messrs. McKinlock of that company, not alone on the enterprise they have shown in undertaking so great an achievement, but as well on the more than anticipated success that has crowned their efforts. A catalogue for business purposes is one thing, but a 700 page, well bound quarto, full of useful and valuable information is a *coup de main*.

* * *

A British Confession.

London Electricity seems to have had a bad night recently and in a spirit of contrition muses as follows:

"We Britishers are sadly behind even some of our colonies in electric lighting and telephony—especially the latter. One has only to travel abroad a bit to realize the many ways in which Great Britain is behind the world." We commend this avowal to the prayerful contemplation of Mr. W. H. Preece.

We have known for some time that our "blew" contemporary was getting hot. We regret the catastrophe has ended in a "burnout."

Shades of the Ptolemies! It is proposed to use the waters of the Nile as motive power for electric lighting plants. Cairo and Assouan are to be lighted in this manner first.

If this talk of using electricity as a means of offense and defense in the event of war is carried much farther we need not be surprised to find that the regular equipment of an army is made to include rubber gloves and pliers.

Our Export Trade.

The "export list" of electrical material is growing quite rapidly lately and is a fair indication that we are selling goods all over the world, including the great electrical centers of Europe, and the remote parts of Africa, Australia, and South America. This is one very effectual way to carry on war against England.

* * *

It is no longer "Edison, le grand magicien!" with our French contemporaries. It has come to be "Edison, l'exterminateur!" This in view of the Wizard's late suggestions anent coast defenses.

The atrocities of the "unspeakable Turk" are to be suppressed in earnest. The telegraph and telephone are to be introduced into the Sultan's private grave yard—Armenia. Talk about an alliance of the powers!

The proverbial slowness of Philadelphia is being just now demonstrated by the disinclination of the street car strike to "move on." The "Hog Combine," however, seems not to have partaken of any of the city's diurnal soporific. It gets there.

"Prof." Reginald A. Fessenden, of the Western Pennsylvania University, has recently evolved a theory in regard to the composition of comets' tails. If "Prof." Fessenden will now turn his attention to fairy tales, he will be more at home than in the realm of science.

If the Chicago Electrical Association hopes to weather the hard gales and reefs and shoals upon which similar institutions have perished, its helmsmen want to keep out in the middle of the stream and not take their bearings from one lonely beacon—especially where the beacon is itself wobbling about without any secure anchorage. In other words the young association will need all hands and the cook to make things go right. Young men, don't prove your inexperience by allowing your institution to be tied up to a single means of publicity.

NORTHWESTERN ASSOCIATION MEETING.

Arrangements are being made for the fourth annual convention of the Nortwestern Electrical Association at the Hotel Pfister January 15, 16 and 17. A. C. Bunce, who has charge of the preparations, says that 150 electricians will attend, representing Milwaukee, Chicago and most of the cities of Wisconsin and upper Michigan. The proceedings will begin at 9:30 A. M., Wednesday, January 15, and reports will be made by the officers, including President George Grimm, of Jefferson, and Secretary William Goltz, of Milwaukee. In the afternoon W. C. Buckley, of Chicago, will deliver an address on Modern Apparatus and Existing Conditions, and Arthur Vaughan Abbott, of Chicago, will speak on Economic Expression for Fuel Value. During Thursday morning and afternoon, papers will be presented as follows: Storage Batteries in Central Stations, Maurice Barnett, of New York; Some Facts About Acetylene Gas, John C. McMynn, of Chicago; Power Transmission Plants, E. R. Cunningham, New York; The Upbuilding of a Small Town, Fred DeLand, Chicago.

The entertainment will include a banquet at the Hotel Pfister, drives and theatre parties.

NOW A ZINC COMBINE.

It is said that at a meeting of zinc smelters held in St. Louis recently, an agreement was reached by which the zinc smelters of the country are placed under one management. A syndicate composed chiefly of New York and Connecticut men are to furnish the money—about $2,000,000. This arrangement will insure better prices and a more easily controlled market. Mr. B. F. Hobart, president of the Kansas and Texas Coal Company, is said to have brought the contending interests together.

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THAT METROPOLITAN CATALOGUE.

It is a unique experience for a business house to be able to sell its catalogue. The Metropolitan Electric Company is having such an experience just now with the mammoth catalogue just out. It is hardly to be wondered at though. It is not alone the most complete electrical catalogue ever got out but contains a vast lot of extremely valuable information, as may be judged by the fact that every mail for some time past has brought to the house orders for the big book, accompanied by a dollar to pay for it. Most of the orders are from people who do not need any electrical goods just now, and who say they have seen the book and want it.

Besides cuts and descriptive matter of about all the electrical material one could well use or even imagine, there are wiring tables, tables of carrying capacity, copper wire tables (weights and resistances), tables of decimal equivalents, comparative tables of guages, definitions of electrical units and formulae, horse power and candle power electrical equivalents, lamp efficiencies, tables of metal weights, conductivity and resistance, the Chicago Fire Department installation rules complete, and other data equally valuable.

Naturally the catalogue (and there ought to be some other name for so elaborate an affair) will reach in course of business. the supply people and users, so that those who are buying the book are among those who are after information compiled ready to hand in this form. Orders from college men, electrical engineers, electrical workers, and students predominate largely in the mails received by the company.

A copy was placed in the laboratory of the National School of Electricity for ordering purposes, and already it is one of the dirtiest books on the shelves, showing constant use for reference by the students.

ELECTRICAL CLUB IN MINNEAPOLIS.

On January 8 an organization was effected in Minneapolis for the bettering of the interests of electrical engineers and men in allied work. The club was formed with the following charter members: Prof. George D. Shepardson, Edwin B. Burch, Chas. H. Chalmers, Geo. A. Lintner, E. A. Scofield, W.W. Dakin, Frank W. Springer, C. L. Pillsbury, V. L. Gray, W. I. Gray, A. H. Savage, W. E. Stephenson, Frank Reidhead, F. E. Chapman, Harry Lackore.

The club membership is to be restricted to electrical engineers or men in allied work. Its object is to provide for a frequent interchange of ideas on topics of interest to the profession, which will be accomplished by holding meetings at which papers on electro-technical subjects will be read and afterwards discussed by the members. Some of these papers will be published and thus given wider circulation. The club starts in Minneapolis with headquarters at Room 23, Syndicate Block, but it is not to be an entirely local organization. Membership will be invited from the towns having relations with Minneapolis. It is hoped to build up a large club, as there are many electrical engineers in the Northwest today and this appears to be the earliest attempt to organize them for mutual professional benefit. The following officers were elected for the first term: President, Chas. L. Pillsbury; first vice-president, Edward P. Burch; second vice-president, Chas. H. Chalmers; secretary, W. E. Stephenson; treasurer, Geo. A. Lintner.

EDISON THE EXTERMINATOR.

Do you recollect the time when, during the siege of Paris, the War Office was daily assailed by inventors of procedures for the annihilation of the Prussians? Immediately after the famous manifesto of President Cleveland, Edison straddled his Pegasus of war and announced that electricity would destroy the ships and exterminate the sailors and soldiers of England. Tremble, enemies of America and the Monroe doctrine! Edison has invented a machine to send water charged with from 5,000 to 10,000 volts to a great distance, which would sweep away an army in two times and three movements. He has also invented invisible and undiscoverable cables with which besieged cities are to be surrounded and which infallibly kill whoever dares to pass them. The electric bill of fare includes electrified chains which are shot through the army, balloons from which are thrown infernal machines or 250 kilogram dynamite cartridges, submarine torpedoes attached to one another like sausages and which, when exploded simultaneously, would sink a fleet in the twinkling of an eye, dynamite guns with four concentric tubes, a double cannon with a range of 30 kilometres, etc., etc. The exploits of Samson who tied lighted torches to the tails of foxes and slew the Philistines with the jaw-bone of an ass are surpassed by Edison the exterminator, the great magician, the electrician of all work. What a civilizing influence electricity exerts and how it modifies manners and customs!—*L Electricien.*

ELECTRICAL OFFICES TO BE MOVED.

There promises to be a big "movement" among the electrical people of Chicago on May 1. Several of the principal office renters in the industry have been caucusing with a view to some concerted action in regard to a centralization of all the electrical interests. All recognize the necessity for such a condition; the only point seems to be the selection of a location.

Many of those holding leases in the Monadnock have signed leases in the new Fisher building just east, and there are said to be several reasons why the Monadnock is not available hereafter. It is generally understood that before the year is old, the whole block immediately east will be covered by a "sky scraper" at least as high as the Monadnock, and as the view of the lake has been one of the chief charms of the building, in such an event, much of its desirability would be gone. It is also said that the rents in the Monadnock and other buildings of the Brooks' estate are about 30 per cent. in excess of those in other new office buildings of the city. Many tenants have also intimated their willingness to have the stars and stripes wave over the building, at least on great occasions.

AN ELECTROSTATIC PAIR.

He was the gallant engineer
Of a giant dynamo;
She sang to the wires the whole day long
With a chorus of "Hello?"

He loved this telephonic maid,
Till his heart's vibrating plate
Was magnetized and polarized
At a miliamperic rate.

His love he well expressed in ohms,
And amperes, or even in volts:
In voltaic phrases and dynamo figures,
Or currents, arc lights and bolts.

Said he: "By the great broken circuit,
Or more, by the Ruhmkorff coil,
Your negative answers will drive me
To some subway under the soil.

"Not a spark of inductive affection,
Not a positive 'Yes' have I had;
I am afraid the wires have grounded
In favor of some other lad."

Then regret, like a galvanometer,
Or an astatic needle, it smote her,
And she said: "Of love I have ions
As strong as an Edison motor."

So he opened the circuit and clasped her
In arm-ature, and held her there;
And she was the belle-electric
Of this thermo-electric pair. —*Hardware.*

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

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TELEPHONE SERVICE IN NORWAY

Trunk and International Lines Under Control of the Government —Local Exchanges Under the Management of Private Corporations.

COMPARISON MADE WITH BRITISH METHODS.

An article by Mr. Alfred R. Bennett, bearing on the tele. phone situation in Norway and making some comparisons with the method employed in England is interesting to those who have contemplated government control of the telephone and telegraph service in this country. Mr. Bennett says:

"Before the late Select Committee on the Telephone Service, it was stated that a committee appointed by the Government of Norway had reported in favor of State acquisition of telephones in that country. But the Government of Norway has, in fact, decided to do exactly the reverse; and the considerations which led to this decision are instructive. Telephone exchanges were first established in Norway, without any Government interference whatever, under concession from the various town councils and local authorities in whose jurisdictions it was proposed to operate. But the Christiania Telephone Company very early in the day proposed to connect its system with that of the Drammen Company, by constructing a trunk line about 40 kilometres in length. The Post and Telegraph Department, fearing that the erection of such a trunk line would interfere with its income from telegrams, promoted a bill conferring on the government a monopoly in all inter-town telephonic lines. This became law on May 19, 1881: but the Telegraph Department, having got its way, did not proceed with the erection of any trunk lines, simply because it had no funds available for the purpose. It, therefore, arranged to license the various companies to connect their systems on payment to the state of an amount representing the estimated loss of traffic in telegrams. Matters so remained until 1892, when the companies and the subscribers, discovering that the sums paid to the government as compensation exceeded the actual loss of income incurred by the Telegraph Department, protested against the continuance of the compensation payments, and petitioned for the abolition of all taxes on inter-town telephonic communication. This move ment made itself felt in parliament, and in December, 1892, the goverment appointed a committee to examine and report upon the whole telephone question. It must be noted that this committee was not a parliamentary or even an independent one, as, with the exception of two managers of telephone companies, it consisted of the director-general of the Telegraph Department and several of his subordinates. The committee was thus chiefly composed of state officials. In February, 1894, it presented a majority report in favor of the acquisition by the government of all the telephone lines, local as well as trunk, but the minority reported in favor of the acquisition by the government of the longer trunk and international lines only, leaving the local exchanges and shorter trunks in the hands of private companies and municipalities.

As soon as the majority report was published, protests were made by the various telephone companies, on the ground that the rapid development which had till then distinguished the Norwegian telephone system would be checked were the management placed in the hands of a central state authority in Christiania, inasmuch as such an authority would seek to make everything uniform throughout the country, ignoring local conditions and requirements, attention to which had been a most important factor in the success of the companies and municipalities. It was also feared that the government would not be able to work so economically as the companies had done, and that it would be necessary to increase the rates of subscription. Color was lent to this assumption by the proposal of the majority of the committee to increase the local exchange subscription in Christiania, which for many years past had stood at £4. 8s. 11d., with most satisfactory results as regards dividend, 5½ per cent. having been paid uninterruptedly for many years, to £5. 11s. ld. A meeting of representatives of the telephone companies and local authorities concerned was convened, and was held in Christiania on April 21, 1894. It was attended by 91 deputies, representing 48 companies and the Trondhjem municipality. Other companies sent protests against the majority report. The meeting, after discussion, adopted the following resolution: "The undersigned deputies from the greater number of the telephone companies in Norway submit that the exceptional development which the telephone has attained in Norway has been due to the manner in which the system has been hitherto managed and administered by local companies and authorities, and this meeting protests against the recommendations of the majority of the committee appointed by the government to consider the telephone question being carried into effect, and maintains that the best and cheapest method of working the telephone is that which has hitherto prevailed. With regard to trunk lines, the meeting considers that the question has not been sufficiently discussed, and it declines to pronounce an opinion as to whether the government ought to undertake the working of the trunk lines; but should the government resolve to acquire and work the trunk lines, then it is recommended that the present tax imposed on these connections be abolished."

In consequence of the strong public feeling displayed against the proposed state monoply in telephones, the government did not take any steps to bring the question before parliament in 1894, but sent a circular to the municipalities and rural authorities, desiring an expression of their opinion on the subject. The reply to the circular was an almost unanimous expression of approval of the resolution adopted by the meeting of telephone representatives. The government, thereupon, decided upon its policy, and during the session of parliament of 1895 proposed, firstly, that the local telephone exchanges should remain as at present in the hands of municipalities, or of companies working under concessions from them; and secondly, that the inter-town trunk lines shall be acquired and worked by the government. This proposal was adopted by parliament practically unanimously.

The present position in Norway, therefore, is exactly the opposite to that which was suggested to the late select com mittee on the telephone service. Municipalities and local authorities have the right to establish their own telephone exchanges, or to license companies to establish exchanges, and this without any reference to government, and without paying any royalty to the post office. On the other hand, the government has acquired a monopoly in the lephonic inter-town trunk lines.

The decision of the government may possibly have been influenced by the fact that the telephone companies followed up their meeting in April, 1894, by forming a telephone union having for its objects the promotion of the telephonic industry throughout Norway by an interchange of views regarding extensions, tariffs, and technical and working arrangements. The union held meetings in Christiania on January 28, 29 and 30, 1895, and, amongst other resolutions, determined to publish a fortnightly newspaper dealing with the thelephone and electrical questions of general interest. Twenty-three numbers of this publication, the Thlefon-og-Telegraf Tidende, have already appeared.

ZINC PRODUCTION.

The production of spelter has increased from 74,004 short tons in 1894 to 85,491 tons in 1895 though the average price of spelter for the year advanced but little, being in New York 3 63 cents per pound as compared with 3 52 cents in the previous year.

The zinc oxide production remained stationary at 22,814 short tons in 1894 and about 22,690 tons in 1895. There was produced in addition to this a certain amount of zinc-lead pigment.

The subscription price to THE ELECTRICAL JOURNAL is $2.

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TREATMENT FOR ELECTRIC SHOCK.

Instructions Issued in Circular Form by the Minister of Public Works of France.

The minister of public works of France has issued a circular to the prefects thoughout the Republic, says the London Electrical Engineer in which instructions are given for the handling of people who have received a shock from live electric wires. The circular says among other things that "the medical treatment of cases of shock is the same in all instances; but the steps to be taken for the preservation of the patient, or the safety of the helpers, are different according to whether the current is a continuous or an alternating or commutated alternating one. According to the Academy of Medicine, the victim, even though apparently dead, must be at once taken, if no longer in contact with the electric wires, to a well-aired place, the number of persons in which is strictly limited to those whose services are necessary. The clothes are to be loosened (trousers and open shirt) and as promptly as possible you try to re-establish the respiration (as in the case of persons apparently drowned) by rhythmically pulling the tongue or by artificial respiration, and the circulation by rubbing the surface of the body, by whipping the trunk with the hands or with wet napkins, throwing cold water on the body from time to time, and bringing ammonia or vinegar to the nose. The method for tongue-pulling is to open the mouth, using force by any convenient means, if necessary, as by the handle of a knife or a piece of wood; to grasp the tongue solidly, preferably with the aid of a pocket-handkerchief to prevent slipping; to pull the tongue forward, firmly and rhythmically, letting it slacken after each pull, about 20 times a minute; and keep this up for half-an-hour, an hour, or more. The method for artificial respiration is to lay the victim on his back, shoulders slightly raised, mouth open, tongue free; grasp the arms at the elbows, squeeze them firmly against the chest, then separate them, and bring them above the head, describing an arc of a circle, then bring them back to their former position at the sides of the chest. Repeat this about 20 times a minute, and keep it up until natural respiration is restored. It is better to begin in every case with the tongue-pulling, and, if possible, to carry on the artificial respiration at the same time. If the victim is still in contact with the wires the salvor must, before acting as directed, get him away from these. But in order to do that he must himself take certain precautions. For example, he must avoid touching him with the bare hands, and must wear thick gloves of dry stuff—linen or flannel of sufficient thickness; and he must not lay hold of the person injured by any wet or moist part of his body, as by his feet or under his arms. It may be necessary to cut the wires in order to free the body. But this is entirely inadmissible in the case of continuous currents on account of the risk to the cutter occasioned by the spark or extra current on breaking circuit. It is not so with alternating or commutated alternating currents. In that case the wire may be cut without danger; but it is necessary to cut the wire on both sides of the victim in order to be sure that the cutting is really of use."

LIGHTNING ON A LARK.

In South Devon (England) recently, two brilliant flashes of lightning were followed by peals of thunder. In a field near Plymouth, which is used as a rope-walk, an "electric ball" was seen. It is described as travelling from west to east, tearing up the ground for 100 yards in its course until it reached the place where two men and a boy were employed in rope-walking. It shattered the lower part of the door of a small house occupied by the spinning wheel, knocked a hole in the wall on the opposite side, and then passing upwards, partly unroofed an adjoining building. It next passed along another rope-walk where four men were working. One of these, named William Morey, was, unfortunately, instantly killed, the two others were knocked down and severely injured.

ELECTRICAL COAST DEFENSE.

Mr. Edison's suggestions for coast defenses in case of war, are the subject of an article in the New York World of December 29.

One suggestion is to run out cables, the extreme end being about 15 miles from the shore. These cables would run on wheels placed at the bottom of the ocean, and to them at intervals would be attached torpedoes of great destructive power. It is proposed to move the cables back and forth from a subterranean workshop, and thus shift the torpedoes under the waves as the ships move. Mr. Edison thinks that the topography of the New York coast makes it easy to so plan a series of these subterranean cables that the English ships would be compelled to pass over one or more of our "submarine necklaces." When a ship has been located over a cable by means of a range finder, a button would be pressed, a torpedo released, and automatically exploded when it struck the ship. He believes that a belt of these cables, crawling like snakes along the bottom of the ocean waiting for invading ships, would make the country secure.

Mr. Edison said that he rather liked his idea of flying torpedoes, and thinks that they would prove to be great pacifiers. But unfortunately, he added, the English ships could bring them over to this country and use them to drop over our cities, whereas it would be difficult for us to control them accurately enough to direct a charge over a ship. He thinks, however, that if we had them first we could send a few over on our fast cruisers and drop them over London or Windsor and thus end the war.

He referred to his plans of fighting by means of electrified currents of water, and stated that with 25 men he could thus make any fort absolutely impregnable as far as assault was concerned. This, he added, is not guess work, but a matter of absolute certainty, and he believes 25 men would be a very liberal garrison to annihilate 10,000 of the enemy. In each fort he would put alternating-current machines of 20,000 volts pressure, one wire of which would be grounded. A man could govern by hand a stream of water of 400 pounds pressure to the square inch, with which the other wire would be connected. Mr. Edison says that a man could run the water back and forth, playing on the enemy as they advanced, and throwing them down with absolute certainty. Every man touched by the water would complete the circuit, get the full force of the current, and never know what happened to him. In trying to take a fort by assault, though the attacking party should number tens of thousands against a handful, he could thus protect it without much effort. He says that it would not be necessary to deal out absolute death unless the operator felt like it. He could modify the current gently so as to stun everybody; he could then walk outside the fort, pick up the stunned generals and others worth keeping for ransom or exchange, and make prisoners of the others, or, if inconvenient, play the hose on them once more and "send them to the happy hunting grouuds for good." Mr. Edison says that when he first announced this plan it was severely criticised, but he thinks that no man could be sufficiently insulated from the 20,000-volt current to protect him from its deadly effects.

WILL THIS COME SOON?

An electrical engineer (ahem!) who airs himself through the Philadlphia Times, says: "Electricity, as is being gradually shown, is fire—the fire of friction, if you will, the first known by the inhabitants of our globe. Look at an arc lamp and see its combined sparks as they emit from the carbons so swiftly that they are taken for a regular flame of ever-bedazzling light. In the ages to come the charges of electricity will keep on accumulating, until some commotion of the earth will cause it to ignite, when, in the twinkling of an eye, our world, with all it contains, will be enwrapt and consumed by a conflagration that will startle if not frighten the inhabitants of other planets as they look down upon the flaming mass and see it burn up—one of the grandest works of the Almighty's creation."

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students. Personal and Pertinent.

ANNOUNCEMENT.

There will be a meeting of physicians at the laboratory lecture room of the National School of Electricity, 335 Dearborn street, Chicago, on Saturday evening, January 25th, 1896, for the purpose of organizing the Electro-Therapeutic class for the course of study of that subject.

The course for this class will be given throughout in the laboratory lecture room at the above address.

The terms for the course are $25.00, payable at once, or in installments, and all members of the medical profession in good standing are invited to matriculate.

The course will differ from that given last year, in that the clinical work will be omitted; the electro-physical part of the course will be reduced from fifteen to ten lectures, and the electro-physiological part from fifteen to ten lectures. The same ground will be covered as last year. An essential difference will be that the best commercial apparatus will be used profusely for demonstration.

The intention throughout will be to instruct physicans in the principles of the apparatus they use in their practice—its management and care; in the physiological action of the various forms of the electrical current, and in the methods to be employed for administering, controlling and measuring the current for the various electro-therapeutic effects desired, and in guiding them by practical demonstration to the selection of the particular form of current desired to overcome various pathological conditions.

The laboratory of the school adjoining the lecture room will be at the service of the physicians, and will be made use of throughout the course, not only during class hours, but in the intervals.

The lectures will be given one evening each week, and as many classes will be formed as may be necessary to accommodate all members, it being desirable to have the classes small enough to make the instruction as largely individual as possible.

On the evening of the organization meeting, there will be some practical demonstrations of the simpler uses of electricity.

All physicians are invited to this first meeting.

ELECTRO-THERAPEUTIC WORK.

Prof. W. J. Herdman, of the University of Michigan and director of the electro-therapeutic work of the National School of Electricity, spent some days in Chicago during the past week, revising plans and directing as to the new year's work in his department. The first work of the school in that department since the '96 term was the organization of classes of physicians, at Minneapolis and St. Paul, to study electro-therapeutics. Only a few changes are being made for the work outside of Chicago, for the coming year. The electro-physical part of the course is shortened somewhat and that part concerning the care and use of apparatus is somewhat extended. Clinical work will not be so closely followed, excepting along the lines of practical demonstration of the use of apparatus.

Strong points are to be made on physiological action of the various forms of the electrical current and the pathology of the lesions in which electricity is indicated as treatment.

In Chicago the work for this year will differ materially from that done last year, as it is possible to take advantage of the electro-physical laboratory for purposes of demonstration. All electro-therapeutic classes in Chicago this year will meet in the small lecture room of the school at 335 Dearborn street. The classes, after passing through the electro-physical part of the course, will be given actual work in applying the various forms of current, with the ordinary apparatus that they are most likely to use in their own practice.

INSTRUCTORS VISIT THE SCHOOL.

During the past week Professor H. G. Brownell, Principal of the Louisville Manual Training School, late Chief Instructor of the National School of Electricity and at present instructor of its Louisville classes, visited the Chicago headquarters of the school. Prof. Brownell's lines seem to have fallen in pleasant places in his new position. He certainly does not have to work so hard as he did with the National School, though in the latter position he was rapidly acquiring a most enviable national reputation. Another visitor to the school during the holiday season was Prof. Edwin Place, of the Rose Polytechnic Institute. Prof. Place has been doing some excellent work in Terre Haute for the National School of Electricity as instructor, the proof of which is that the school is asked to renew its work in that city this year.

THE ELECTRICAL SCHOOLS.

During the past year or two, and within the last year in particular, there has been an awakening of interest in the electrical schools on the part of practical, working electricians. The sometime prejudice against schools which teach the technique of the science is rapidly disappearing, under the newer and better methods which now prevail.

The prejudice which formerly existed was not without its reasons, and good reasons. Many of the so-called courses of electrical lectures were superficial and attenuated to a degree. Almost every practical, working electrician has had experience which emphasizes the hollowness of these lectures. It has been a common practice for professors of the technique of the science to visit a station, quiz the intelligent, practical man who was in charge and learn the practical working of the machine or system, as the case might be. Upon knowledge thus obtained, legitimately enough to be sure, the lecturer constructs his fabric. The information, simple enough in itself, when once fully understood from the explanation by a practical man, is dressed up in the nomenclature of the science, and when delivered from the rostrum, mystifies even the operator who gave the information which formed its motive.

There is not a practical electrician that reads these words who cannot recall just such incidents in his own experience. It is this superficial, if not indeed unfair treatment of practical electrics, which was, to a great extent, responsible for the lack of interest taken by practical men in the popular lectures on electricity which were, for a time, so much in vogue. The change in methods, before referred to, however, has to a great extent, wrought a marked change in sentiment. There are several electric classes in Rochester, which are attended by high-grade practical electricians, to both their pleasure and profit.

The National School of Electricity has not been without its critics, but the Rochester branch of that school under the direction of Professor A. L. Arey, is having a singularly successful session, most of those in attendance being practical electricians. The course of study, which is conceded to be very thorough, has been rigidly adhered to, and under the intelligent guidance of Professor Arey, himself a thorough, practical electrician, the members of the class are rapidly adding to their knowledge of theory of the science. The interest in the school is unabated, and is in fact greatly increasing, as the lessons reach subjects with which the pupils are familiar in their everyday life. Whatever may be the case elsewhere, the work of the National School of Electricity, as demonstrated before a class composed principally of men who are expert in their various branches of the art, has been a marked success.—*The Station*, Rochester.

During 1894, 3,315 patents relating to electricity were granted in the United States, Great Britain and Germany; of these, 1,704 or 51 per cent were American, 1,130 or 34 per cent English and 481 or 15 per cent German.

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ELECTRICITY AS A PROFESSION.

Publication has recently been made of records stating the business success of the graduates of several leading colleges of engineering—the Massachusetts Institute of Technology, the Stevens Institute, the Rensselaer Polytechnic, the engineering department of Cornell, and others. The showing is a really remarkable one, both in the high average of successful careers achieved by so large a body of alumni, and as a testimony to the value of mechanical science as a branch of modern education. It impresses the reader with the importance of the posts held by the men who in this age of machinery stand with their hand on the levers of the great forces that do the work of the world.

It would seem that the profession of engineering is not an overcrowded one; that its qualified practitioners are not multiplying more rapidly than the growth of the demand for their expert services. Herein it offers, at the present time, a more promising field to the young man than those of medicine and the law. Its great prizes are perhaps scarcely equal to theirs, but to the rank and file it affords a readier footing.—December *Munsey's.*

PAYING FOR BRAINS.

Those who determine the rate which shall be paid to labor in the great majority of the shops do not seem to realize that brains are just as desirable in the management of the shop or drawing room as in the management of the finances of the company. The treasurer who can guard his finances so as to save a half per cent. here, or a quarter there, in some shrewd business deal is looked up to as a man to be retained at any cost and no salary within reason is too high for him to receive. In the shop it is different. The right kind of a foreman is continually saving money for the firm and in many cases actually saves many times the amount which the financial man boasts of, yet he only receives "shop pay" which seldom exceeds four dollars a day for a shop foreman and which is considered good wages. It is the same in the drawing room. Mistakes here are costly, and the brainy man in charge of this department can save more in proportion than almost any other officer or employe; yet how seldom is it recognized in a substantial manner, and we find draftsman about as poorly paid in proportion to their work as the men in the shop. But, some will say, they cannot afford to pay a large salary; and if they cannot they should not expect a high grade of work or managing ability. The man who can save a thousand dollars a year is certainly worth more than the one who can save only a hundred, yet this is too seldom given sufficient consideration in determining the salary due. While the demand and supply of labor largely regulates its rate of remuneration, none can deny the justice of giving each a fair share of the product of his or her labor and if a man can save you money (which is equivalent to adding to your profits) he certainly deserves a fair share of savings.—*Railway Review.*

THEORIES OF ELECTROLYSIS.

C. Dampier Whetham, in Science Progress, gives an interesting study on the theories of Electrolysis. Starting with the application of Ohm's law to electrolytes, he discusses the evidence which Kohlrausch educed in regard to the specific character of ionic velocities. The hypotheses of Arrhenius, Ostwald and others concerning dissociated ions are next considered, and a number of interesting tables have been compiled by the author bearing upon the coefficient of ionisation and constants of affinity of a number of electrolytes. The dependence of general physical properties, such as the osmotic pressure, freezing point, etc., upon the electrolytic characteristics of the liquid are discussed in relation to the researches of Mr. H. C. Jones on this subject. From established data, the author proceeds to summarize the hypothesis in regard to the dissociation accompanying the solution of highly stable solids. In regard to this branch of the subject he arrives by independent reasoning at the concusions: "The pairs of opposite ions must be separated, and the ions exist free from each other's influence, and, secondly, that there must be a tendency towards the formation of more or less stable molecular aggregates between salt and solvent." The apparent contradiction involved in these two conclusions is got rid of by the fact that "since it is evident that one salt molecule can influence a large number of water molecules, it follows that the chemical forces are very far-reaching."

ALUMINUM PRODUCTION FOR 1895.

The Pittsburgh Reduction Company during the year started up its new works at Niagara Falls, taking 4,500 H. P. from the Niagara Falls Power Company. The addition to its facilities enabled the company to turn out 850,000 pounds of the metal, an increase of about 100,000 pounds over 1894. The increase was readily taken up, and the demand for the metal is still beyond the capacity of production. The company has arranged to double the size of its plant and to increase the production accordingly, having contracted for an additional 4,500 H. P.

No new uses for aluminum were developed during the year. The demand for the pure metal has been largely for the manufacture of small articles and household utensils, the demand for which is increasing. The cost, as heretofore, continues to limit the use.

The production in Europe is still controlled by the Neuhausen Company in Switzerland, which controls the French works as well as its own, and is gradually extending its operations. The production, however, has not yet been much increased, and is estimated at about 750,000 kilo. for the Neuhausen and Froges Works. The British Aluminum Company, which purposes making the metal from Irish bauxite, has not completed its works, and it is uncertain when it will become a producer.

SUBMARINE ELECTRIC RAILWAY.

A railroad is being built in England which for uniqueness surpasses anything heretofore conceived. It is to be a submarine line, so far as the road-bed is concerned, the rails being fifteen feet below the surface of the sea. The road when completed will run between Brighton and Rottingdean. The line is being built for pleasure purposes only, and is intended to give the passengers the benefits of the sea air while they are riding over it.

The rails are laid on concrete blocks three feet apart, mortised into the solid rock which forms the ocean's bed along that coast. The road will be of very peculiar construction and gauge. It will be a four-rail track, two tracks being spaced two feet eight and a half inches apart, and the other two eighteen feet apart. The wide gauge is necessary to give the required stability to the cars. The rails are secured to the concrete blocks by steel clips and bolts. Tie rods are also used every ten feet on the straight and every five feet on the curves, heavy angle fishplates being used for the rail joints.

The cars for the road will carry the passengers at a height of twenty-four feet above the level of the rails and about nine feet above the waves. Each of these cars will rest on sixteen wheels thirty-three inches in diameter. Between these and the cars will be four main legs in the form of tubes of drawn steel, eleven inches in diameter. At the bottom of each leg is placed a truck having four wheels. The outside of these trucks are shaped like an inverted double-ended boat to facilitate its passage through the water and to remove any obstructions from the rail. The four trucks are bound together by steel tubular struts. The tops of the main legs are built into lattice girder work, which carries the deck. It in turn is built as for a yacht. The deck measures fifty feet in length and twenty-two feet in width. Each car has space for from 100 to 150 passengers.

Electricity will be the motive power for this road, two thirty-horse power motors being used to operate it. The current of 500 volts will be carried to the car by an overhead trolley. The cost of building the road has been placed at $100,000.

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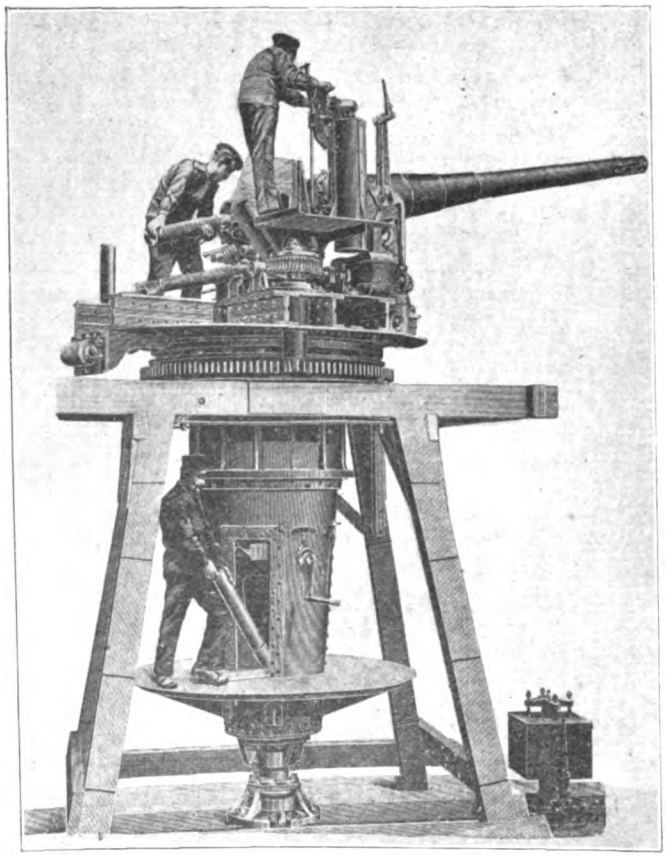
ELECTRICAL TURRET SERVICE.

Turrets of Danish Coast Guard Ships Operated by Electricity In Place of the Hydraulic Machinery Heretofore Employed.

CANET SYSTEM INSTALLED ON THE SKJOLD.

M. Georges Davy, who is a recognized authority upon coastguard defenses, contributes an interesting article to L'Electricien of December 28, which we have translated and abstracted.

The day of the hydraulic service motor in the marine service, says M. Davy, has passed, and the electric service motor reigns in its stead. In the preface to the author's work on "Coast Defenses," Admiral Revillere says: "The conductors are not cumbersome, they follow the most irregular contours, and their weight is less than that of other conductors. They can be easily repaired or replaced when damaged or cut in battle. Electric



motors are always ready for duty, they obey with mathematical accuracy the action of the manipulator, they can be suddenly stopped by powerful brakes. They do not have the leathers nor the joints so difficult to make water tight, of the hydraulic machines. Freezing does not affect the electric motors at all." These wise conjectures have been justified by the experience in the war between Japan and China when in the siege of Wei Hai Wei the pipes of the service motors froze and had to be thawed out by fires in the turrets.

Lieutenant A. Bradley Fisk, of the United States Navy, insisted with like earnestness, in 1888, upon the utilization of electric energy for service motors and summed up by saying that their superiority was incontestable, that they were more simple, more durable, worked noiselessly, required less care and rendered unnecessary the heavy water pipes which were so liable to get out of order at critical moments. He said, moreover, that the conductors were less liable to be cut by projectiles or accidents and could be more easily repaired and replaced.

It must be remembered that in the generality of hydraulic service motors, the movements are so combined that the third cannot be made unless the second has been made and that it is impossible to change from automatic to hand service.

In the "Neptune," for example, an accident to the delicate mechanism occurred which rendered the entire turret useless before the battle. The time is near at hand when foreign navies more audacious or more clear sighted than France will adopt a system of cannons in turrets manoeuvred by electricity and will replace the cumbersome and fragile network of tubes which become useless upon the slightest accident, with electric service motors.

From 1888 to 1890 experiments were made in this direction by the Societè des Forges et Chantiers de la Mediteranèe, following the initiative of M. Canet. The Chilean cruiser Capitan Prat, built by this company, was equipped with turrets manoeuvred entirely by electricity. The French second-class cruiser Latouche-Trèville has also been equipped with the Canet turrets.

The same system has been installed in about 40 turrets of various sizes and for different ships. The most recent installation is that of the Danish coastguard ship Skjold. This boat has three turrets, two for guns of 12 centimeters and one for a 24 centimeter gun. In all these turrets hand service can be substituted for electric service by a simple mechanical arrangement without loss of time. In the large turret electricity is employed to the pointing of the gun and the hoisting of projectiles; while in the smaller turrets (see figure) it is employed only for pointing the guns. The cartridges are hoisted to the platform by an endless chain and by carriers operated by hand, which is entirely satisfactory for guns of small calibre. In the case of guns of 24 centimeter caliber the excellent results obtained from the electrical service in the "Latouche-Trèville" have been confirmed by the recent tests made on the "Skjold" off Havre in the presence of the Danish commission and a large number of French and foreign officers. The service of the turret is constant and under perfect control. The movements of the platform can be instantaneously arrested and the gun can be levelled with remarkable rapidity and precision.

By reason of the ease with which all the parts of the Canet turret are balanced, this heavy mass can be moved with a relatively great rapidity and without shock or reaction; furthermore, the energy required for this movement is reduced to a minimum. This turret, with its 24 centimeter calibre gun, its massive platform and carriers, can be moved by an electric motor of 15 horse power nominal. The hoisting power for projectiles is operated by a special 8 horse power electric motor, and by the aid of a commutator the necessary movements for loading the projectiles upon the hoist, raising it and loading the gun, can be made; the action of this cumulator is automatic. A 3 horse power motor is sufficient for the smaller turrets.

NEW ELECTRICAL JOURNAL.

The "Station" is a new electrical monthly issued for the first time January 1st, from Rochester, N. Y. It is devoted, as stated on its front cover to "the thing called electricity." It is magazine size, of color closely approaching that of THE ELECTRICAL JOURNAL, and is full of good practical things. Mr. John Dennis, of the Democrat and Chronicle, is prominent in the management and is the chief contributor to the first number, which means that the paper is in the best possible hands, as Mr. Dennis is well known as a hard student, close observer, and thoroughly equipped writer.

Some of the articles in the January number are devoted to: "A Notable Instance of Parallel Working," "The Motorman and His Car," "Practical Resuscitation," "An Auxiliary Fire Alarm," and "Bucking of Street Car Motors." These titles will indicate the general very practical character of the work cut out for the new periodical.

We welcome most heartily *The Station* into a field whose ideals are constantly being raised and whose tillers must work hard and be well equipped to hold up their end.

Send in your subscription to THE ELECTRICAL JOURNAL.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

POSSIBILITIES IN TELEGRAPHY.

Mr. Charles Cuttriss, of the Commercial Cable Company, has sent the following answer to the New York Herald in reply to an inquiry:

In reply to your telegram asking what is the most needed improvement in telegraphic service, I think placing underground cables along the railroad tracks between important business centers would tend to make the service most reliable; and the perfection of a rapid page printing telegraphic machine, with keyboard adapted to the use of any one who can use a typewriter, would tend to make a service that could be used by the layman in small towns without going to the expense of maintaining a regular operator. These points are now being considered; and their perfection is only a matter of time.

THE TELEPHONE IN NORWAY.

Norway is the best telephoned country in the world, in spite of the fact that 70 per cent. of its area is uncultivatable, and another 4 per cent. is forest. It has one exchange for every 7,812 inhabitants and one telephone to each forty inhabitants—eight and a half times the number in this country.

The American Bell Telephone Company has in use at the present time 676,536 telephones.

Light and Power.

ELECTRICITY IN POWDER MILLS.

The recent gradual increase in the use of electric power in powder mills is especially noteworthy. During the past year the General Electric Co. has equipped several with electric motors, and present indications point to a more rapid introduction of such equipment in and about powder-manufacturing establishments.

In November, 1894, the Ætna Powder Co., Ætna, Ind., decided to install two small slow-speed generators for operating incandescent lamps on the Edison three-wire system. As these could not be delivered immediately, two second-hand machines were installed temporarily, and before the first two new ones ordered could be delivered, the order was changed to two larger moderate speed generators, with the privilege of changing them for two still larger ones. In June, 1895, the last two were ordered, together with two motors, one of one horse-power, the other of five horse-power. On August 2 the Ætna Company ordered another motor of five horse-power, and on August 14 still another of the same capacity. The company having enlarged its plant during the summer, found its electrical installation insufficient, and on October 12 ordered two 45-kilowatt moderate speed generators and two moderate speed motors, one of twenty horse-power, the other of thirty horse-power. Thus within one year electricity had given the powder company such satisfaction that it now has sixty-six horse-power in motors and ninety-three incandescent lamps taking current from the two 45-kilowatt generators. The one horse-power and the five horse-power motors are used to drive small mixing machines in the manufacture of dynamite. The thirty horse-power motor operates a large machine used for pulverizing nitrate of soda, and the twenty horse-power runs a number of machines, such as the dry pan and mixing machines. The powder company reports that the first five horse-power motor, which was substituted for a steam engine, performs a duty which the engine found difficulty in doing.—*Manufacturers' Record.*

The report widely circulated to the effect that Queen Victoria was opposed to the electric light seems to have been without foundation in fact. It is now announced that Balmoral Castle is to be lighted by electricity, the ball-room being first equipped at an estimated outlay of £1,400.

ELECTRICAL CONCESSIONS IN PARIS.

The municipality of Paris has been for some time considering the question of making contracts, says an editorial in L'Industrie Electrique, with the various companies controlling the distribution of electrical energy, advantageous alike to the city, the companies, and the individual consumer. In consideration of an extension of concessions for twenty-five years with suitable allowances each year for wear and tear of material, the companies have accepted a considerable reduction of the maximum tariff both for electric light and power. The increase in receipts under these new conditions, will to a great extent, make up for the diminution in tariff rates. The city will have a better service, the consumers will pay less for the power and light they use, and the companies will be equally benefited by the extension of their concessions, which means to them a great deal of money. After the report had been made to the Municipal Council and that body was ready to pass upon it, and its passage appeared certain, the death of M. Atout-Tailfer, the committee on the subject, threatens to nullify the work already done. It is to be hoped that the new committee will not insist upon doing the work over again for motives of personal aggrandizement, but will accept the report of its esteemed predecessor in the interests of all concerned.

A case of some interest to the central lighting stations and incidentally to the business community at large will be decided within a short time in New Jersey. The case has been on trial at intervals since 1894. It was a suit brought by T. J. Preston & Co., of Newark, against the Newark Electric Light and Power Company. The contesting parties occupied adjoining buildings. The ground for complaint on the part of Preston & Co. was that the vibrations caused by the dynamos and heavy machinery of the lighting company caused their building to vibrate so that their oil stored there had decreased in commercial value and that in consequence a material loss had been sustained. The last evidence put in by the defendant is expert testimony to show that no matter how substantially such stations are built they are subject to vibrations and hence that no liability rests with the owners. The suit was for $100,000.

The Lewiston and Auburn (Marine) Electric Light Company has leased the valuable water power on the Little Androscoggin river known as the Gay power, situated near Littlefield's Corner, formerly occupied by the American Light and Power Company. This water privilege has a fall of twenty-four feet and is estimated to furnish at least four hundred horse-power. The steadily growing demand for incandescent lights and electric power has made it necessary for this company to obtain increased power in some direction, and the location of this privilege is so favorable in connection with their present plant that it is considered an especially valuable acquisition. Three arc and one incandescent machine will be placed in this station at once, and more will be added as demand requires.

LIGHT IN SPRINGFIELD, OHIO.

The Board of Public Affairs of Springfield, Ohio, signed on December 30, a contract with the Springfield Light and Power Company extending over a period of five years. The contract calls for 200 arc lamps of 2,000 candle power to be located where the Board of Public Affairs direct, to be kept burning continuously every night from half an hour after sunset until one hour before sunrise. For this service, Springfield is to pay eighty-nine dollars per lamp per annum.

Polo, Ill., has made a most advantageous contract for its electric lighting. It pays $1,500 per annum for 45 arc lamps, or $33⅓ per lamp per annum. Where the contracting company derives its advantage is not so obvious.

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Logansport, Ind., makes a good report of its municipal electric light plant. Under the previous arrangement 100 arc lamps were used at a cost of one hundred dollars each. At present the city has 155 arc lamps in service the cost of which is more than defrayed by the receipts from the 4,500 incandescent lamps supplied to private consumers at a rental of seven cents per kilowatt. The cost of running the plant is about $850 per month and the receipts for December were $1,250, making a net profit for the month of about $400 or 32 per cent.

The electric company which has secured the concession for lighting Vancouver, British Columbia, offered to supply electricity to private parties "at half a cent per ampere hour." The council not knowing what this meant and in default of obtaining knowledge on this important point have, it is said, sent to Chicago to find out what that part of the signed contract means. British Columbia would seem to be a fruitful field for electrical missionaries.

Braddock, Penn., has decided to make electric companies pay their taxes. An ordinance taxing wires and poles was passed last April, but the companies have paid no attention to it. The Borough Council has instructed its engineer to count all poles in the Borough and estimate the number of miles of wire, and the companies will be compelled to settle at once.

The Boulder (Colorado.) Electric Light Company has re-elected its Boulder directors and the officers of the last year were re-elected by the board. The usual semi-annual 5 per cent. dividend has also been declared by the company.

Beatrice, Neb., contemplates the erection of an electric light plant capable of providing 50 arc lights and 1,200 sixteen-candle power incandescents at an outlay of about $15,000 for machinery and supplies.

The Beresford, S. D., electric light plant and the Wakonda mill under the management of the Northern Water Works and Power Co. have been closed under a $25,000 mortgage foreclosure.

It is currently reported that a controlling interest in the Syracuse (New York) Electric Light and Power Company has been sold to the Boston bondholders of the company.

The electric light plant at Sullivan, Ill., burned out January 6. The loss is estimated to be $25,000, not insured. Sullivan is in darkness.

The electric light plant at Cardington, Ohio, was destroyed by fire January 7. Loss, $9,000.

Railways.

OSHKOSH RAILWAY IN TROUBLE.

Attorney-General Mylrea has ordered the officers of the Central Wisconsin Electric Company, which owns a street railway franchise in Oshkosh, to show cause before the supreme court why its charter should not be revoked.

The company was organized through the efforts of J. T. Tillotson and the present difficulty is the outcome of the attempt of C. E. Loss, of Chicago, to collect moneys alleged to be due for rails. A suit is now pending for the appointment of a receiver for the company and the rails have been levied upon.

The franchise of the company expired January 1, but an extension has been secured from the Oshkosh council until June 1, by which time the company hopes to be ready for operation.

The Moline Water Power Company has awarded the Trump Manufacturing Company of Springfield, Ohio, the contract for an important extension of the company's capacity for generating electric power by means of water wheels. The new turbines, twelve in number, with the present steam power will produce a total of 6,000 horse-power.

The Electric Storage Battery Company, of Philadelphia, will install a chloride accumulator street railway system at Brookline, Mass. Current for charging the batteries will be purchased from the Newton, Mass., Street Railway Company.

Many of the bridges and viaducts in Chicago have been pronounced unsafe for the heavy trolley cars now passing over them and immediate steps will be taken to strengthen them. The question as to whether the city or the railway companies or both shall bear the expense is now causing considerable discussion. The city maintains that the expense should be borne by the railway companies while the latter profess to be straining a point in offering to stand one-fourth the cost.

A great advance step has been inaugurated in Chicago by the West Chicago Street Railroad Company in the operation by electricity of several of its night lines. Heretofore the electric service continued only until about one o'clock in the morning, horses being called into service from that time until the regular day runs began. Hereafter the lines will be operated throughout the 24 hours by electric power.

There are rumors afloat at Niagara Falls, Ont., to the effect that the Niagara Central Railroad running from that village to St. Catharines may be equipped with electricity. If this is done, there will probably be a re-organization or the road will pass into the hands of the Toronto, Hamilton & Buffalo Railway.

Electrician Barnes has reported to the State Board of Public Works of New York in favor of a "tow-motor" rather than the cable trolley system for propulsion of boats on the Erie Canal. The motor is intended to run on rails on the canal bank.

General News.

THOUSAND VOLTS TO KILL.

A suit has just been decided in Limburg, Germany, which would create a good deal of surprise in this country. Two persons were killed by coming in contact with a live wire belonging to the Algemeine Elektricitats Gesellschaft. It was shown that on the day of the accident the voltage did not exceed 8 0. The managers of the company contended that less than 1,000 volts had not been known to kill previous to that time, hence they could not be held to account on the score of negligence or carrying an excessive current. The judges agreed with this contention and declined to hold the company.

Dr. James Webb Rogers, of Pan-electric fame, died at his home in Maryland January 3.

The Springfield Union advocates the putting of all wires underground, not only in cities, but between distant points as well, so as to avoid the delays so often occasioned by storms. It contends that in the long run it would be money saved to the companies.

WATER PIPE INJURED BY LIGHTNING.

The Genie Civil of Paris, tells of a curious accident to water pipes from lightning: "On October 9th it was found that the water supply of a suburb of Havre was cut off, although the pressure at the distributing point should have been 36 to 44 lbs. per square inch. It was evident that a leak or a stoppage had taken place. Tests showed that it was a leak. The mains were examined, and it was found that a number of lengths of pipe were split. On looking into the matter more closely the pipe was found completely perforated at a spot where the root of a tree was just touching it. Now, on October 9th this very tree had been struck by lightning, and from the point of puncture for a distance of 80 metres almost every length of pipe was split longitudinally. M. Houdry thinks it worth while to call attention to this curious instance, with a view of warning those who are entrusted with the laying of water pipes to keep as far away as possible from trees, not only on account of the damage that may mechanically be done to the pipes by their roots, but on account of the damage that may be done by lightning."

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

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SIR WILLIAM SIEMENS.

Born Apr. 4, 1823. Died Nov. 19, 1883. Invented the Siemens Armature and the Self-Exciting Dynamo. First to Transform Mechanical into Electrical Power, and vice versa. Without the Aid of Permanent Magnets.

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The Electrical Journal.

Vol. 1. CHICAGO, FEBRUARY 1, 1896. No. 17

ECONOMICS IN STATION WORK.*

Modern Apparatus Discussed in Relation to Existing Conditions—Suggestions to Purchasers for the Selection of Equipment.

STATISTICS SHOWING COST AND PROFITS.

Two things are constantly changing the conditions of your plants, namely, the development of new apparatus and the reduction in price of supplies.

The money earning station fits its apparatus to its service; not the service to the apparatus. If you charge $10 a month for a 2,000 candle power arc lamp and your customer regards you as a robber, it would seem expedient to furnish either a smaller arc or a big incandescent lamp service at meter rates, thus reducing the price, but not the proportionate profit.

A big cut in your 2,000 candle power rates will transform that service into a non-paying investment, while a service of half the candle power at half the cost of production will pay a profit.

The big incandescent lamp is a money-making factor ignored by a majority of operating stations, either through lack of knowledge or appreciation of the fact that efficient 100 to 500 candle power lamps are selling at a price that commend their use.

Unless you are running a modern plant, it costs $6 per month to produce and maintain a 2,000 candle power arc lamp. This applies to the average station, and will be believed by the stockholder who has been in business long enough to see his intended investment enlarged, his plant rebuilt and his prospective profits used up long before they reach him in the form of a cash return, in expenditures necessary to meet unlooked for changes or unwelcome competition. One of the chief elements of the latter is the Welsbach burner. This competition you have met in your various ways; yet you are all doubtless impressed with the fact that it has come to stay; not perhaps in its present form, but in a new and improved burner which eliminates some of the many glaring faults of the original. The quicker this competition is met, the easier and cheaper it is overcome.

But how?

Many men of many minds would have as many answers.

The president of the Calumet Gas Company of Chicago, operating the second largest arc plant in this country, thinks the strongest competing service is an arc system in "blocks of five"—500 candle power arc lamps, $\frac{5}{16}$ carbons, $5 per month, five per cent. discount when paid within five days after the first of the month.

In this consideration we may assume: First, it is unnecessary to bodily buy the gas company, or, secondly, sell your holdings at a sacrifice. If you can sell at a price and will not, we take it that you are running your station for the sake of your health, in which event, the Welsbach burner becomes a mere diversion breaking the monotony of an otherwise peaceful life.

The Welsbach fad strikes a town over night and goes through it like measles. It lasts about nine months, will usually displace one-third of your lamps in service, which, owing to the many objections to the burner, developed in its use, gradually return like lost sheep to the fold until the former output is reached, if not passed, by the demand created for a more liberal illumination.

The first change found necessary in your operation is to increase the candle power of your lamps to a competitive brilliancy. With 16 candle power lamps sold at 85 cents this might prove disastrous, but with better lamps at 18 cents a piece, it becomes a necessary virtue. This will not decrease your profits as much as your first thought might suggest, for the increased voltage will run your meters fast enough to make up the added expense, provided you sell your current through meters. If you do not do so, the added revenues of those who do, would suggest that you climb in the band wagon and buy meters for your entire equipment. It is a money earning proposition to you and a satisfaction to your customer, who is pleased with his daily inspection of current used, even if the meter is 25 per cent too busy.

In this connection the advisability of accurate switch-board instruments and their periodical calibration with a standardized instrument is clearly shown, as a comparison of the station output with the receipts will immediately uncover any leakage in in the revenue.

The increasing of your pressure will disclose, if your experience has not already proven it, the inefficiency of small transformers of any make. The ground losses on the line and the copper and iron losses in the transformers of the ordinary alternating station are uselessly and unnecessarily large. Four out of seven stations tested by me in the last three months for their constant load loss have shown that less than two-thirds of the current generated reached the lamps. One station employing a 90 kilowatt, 1,800 light, 1,000 volt alternator, with 1,842 lamps wired, gave an output of 70 amperes at the switchboard when 840 lamps were burning. The lamps, which were all of one make, were counted between the hours of 7 and 8 p. m., when the customers were requested not to turn off or on any lamps in that interval. The test showed that current for 1,400 lamps had generated at the station with a constant load loss of 28 amperes. This loss should not exceed eight amperes. The current at the switchboard running 840 lamps should have registered 50 amperes, all of which would indicate that this station ran with a constant load loss of 20 amperes, or current enough to supply 400-16 candle power lamps, for which the station received no pay. This useless loss was eliminated by putting triple petticoat porcelain insulators in place of the single petticoat S. G. glass, removing one fixed and one intermittent ground on the line and changing 1,400 lights on 5, 10 and 25 light 50 volt transformers to two 250 light, eight 100 light and two 50 light 100 volt transformers. The balance, of 400 lights, were on the residence circuit and were changed from 50 to 100 volts without materially decreasing the size of the transformers. When these changes were completed the output at the switchboard was 51 amperes with 898 lamps burning. While formerly most of the output was sold at a given rate per lamp per month, when the change was made every lamp was put on meter, and the losing station converted into a paying property.

*Paper read January 15th by W. J. Buckley, at the Milwaukee meeting of the Northwestern Electrical Association.

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Increasing the candle power will apply to the same extent in meeting ordinary gas competition. We know the public is willing to pay a fourth to a half more for electric light than gas, provided they get full candle power. Taking gas and incandescent lamps at an equal candle power the equivalent rates would be as follows:

Gas at $1.00 per thousand equals 16 c. p. lamps at ½c. per hour.
" 1.50 " 16 " " ¾ "
" 2.00 " 16 " " 1 "

This presumption will certainly leave a fair margin of profit on a competitive basis, as the life of the incandescent lamp cuts but one-fifth the figure it did four years ago. The pioneer usually forgets this change in lamp values, and through force of habit and training keeps down the incandescent candle power.

A new rule hung on the switchboard should read: "Keep up the candle power to keep your job."

The following table of efficiencies of 100 volt 16 candle power lamps is the result of a test made with some of the prominent makes:

Thomas-Houston	62 amp.	62 watts	3.875 watts	per c. p.
Edison	55 "	55 "	3.437 "	"
Buckeye	56 "	56 "	3.50 "	"
Packard	57 "	57 "	3.562 "	"
Bernstein	65 "	65 "	4.062 "	"
Beacon	54 "	54 "	3.375 "	"
American	58 "	58 "	3.625 "	"
Columbia	61 "	61 "	3.800 "	"
Keystone	56 "	56 "	3.500 "	"

The price delivered and the guaranteed life are other points which decide the preference, but I hesitate to include the life test through a dislike of a probable criticism of advertising some particular lamp; and again each batch of lamps filling a given order from almost any maker seems to vary from the average life of the preceeding lot.

The "New Lamp," like the "New Woman," will curtail the material used in construction and produce more effect with a given energy.

A lamp having a life of 500 hours and making 2½ watts per candle power at 18 cents apiece, or still better, a 300 hour two watt lamp, will greatly increase our competitive strength.

The contingency arising from an opposition plant entering your field with neither your permission nor pleasure is, of course, governed by local conditions and your judgment.

Filled with Chesterfieldian courtesy you might introduce your enemy to your customers and also show him your earnings from the starting of your plant. Not only would your sincerity be doubted but he would believe you made twice the profits shown; and that if you did not he could; and even this belief would be direct-coupled with a mental pity of how much you have yet to learn in your business. You might even allow there was room for two, or you might conclude to let him go ahead and hang himself on his own proposition. Meantime it is demoralizing your customers, dividing either your business, your profits, or both, and worst of all, constantly reducing the fixed valuation of your property.

Referring again to the Calumet Gas Company, as a successful fighter of competing plants, I will add that this company has but one rule—fight from the shoulder. Drop the prices down at one stroke to a point where the other fellow must lose. Deprive him of all revenue and he is forced to quit. This rule has placed the price of 1,200 candle power arc service in certain districts of Chicago at 10 cents per night, $2.60 per month.

It may be expedient to state that the Calumet Gas Company has money and a modern plant. If you have neither, the value of fighting from the jump is not altered, as it forces you to draw on other resources to modernize your station, a good thing in itself, or without resources it compels a more liberal and immediate purchase of your plant.

To-day power, arc and incandescent service is produced from the same machine, and any agreement to divide the service is liable to daily abrogation.

The best protection to the value of your property and its revenue is to keep it modernized. This contemplates a continuous expenditure anticipated and met by the money earning plants.

The development of the business has demonstrated the economy of large units. In arc service the 100 to 125 light machines have displaced the 35 to 50 light units with a saving in maintenance of 40 per cent.

In direct current service the large units effect a saving in maintenance of 20 per cent., which is increased up to 50 per cent. by being direct-connected.

In alternating current service, the large units effect a less apparent saving in current efficiency, but the slower speed, lower temperature and ability to run continuously make their adoption a commercial gain, apart from the simplification of circuits.

Speed and weight should govern the price of all types. A dynamo running at 600 revolutions weighs nearly twice as much as one of the same design and rated capacity at 1,200 revolutions. It costs 70 per cent. more to build. Hence, a direct-connected dynamo at 275 revolutions is worth 70 per cent. more than a belt-driven machine of the same design at 550 revolutions. When the armature is built directly on the extension of the ordinary engine shaft, this may be reduced to 50 per cent. on the account of the doing away with one box, pedestal and part of the frame.

Suppose a purchaser wants a direct current belted machine of 100 horse power, or 1,000 light capacity. He finds the cheapest type a bipolar machine, say with a speed of 1,200 revolutions, weight 6,000 pounds, price $900, average efficiency 80 per cent. with an armature life of two years if loaded. In the multipolar machine he finds the high-speed belted dynamo at 1,100 revolutions, weight 6,500 pounds, price $1,000, same efficiency and life as bipolar; the medium-speed dynamo at 550 revolutions, weight 11,000 pounds, price $1,400, 85 per cent. efficiency, armature life five years; the slow speed, 275 revolutions, weight 17,000 pounds, price $2,200, 87 per cent efficiency, armature life eight years.

Thus we have dynamos of the same make, if you will, and each of the same rated capacity in horse power, lamps or kilowatts, ranging from $900 to $2,200 in price, the more expensive machines not always receiving at your hands the consideration they deserve.

The dimensions of the base frame of any dynamo will show when too great a preponderance of weight is delegated to that inanimate object.

Again, the rating given a dynamo by the maker should not always be accepted. The various machines offered should be placed on the same basis of estimating their capacity, namely, assuming the highest point of efficiency as full load, the added capacity of the machine beyond that should be regarded as an overload. Most dynamos are rated at their utmost capacity, irrespective of efficiency or temperature.

A 150 kilowatt alternating dynamo rated at 130 amperes and 1,150 volts is worth but 86 per cent. of one of equal quality rated at 150 amperes and 1,000 volts; the first being the output at the dynamo, the latter the output at the center of distribution, where it belongs.

This difference in actual value is reduced to 75 per cent. if the first dynamo is rated at full capacity and the latter at its most efficient output.

It may be a question of the value of money to you whether you can afford to buy slow-speed machines at their increased cost.

The Harrison street station of the Chicago Edison company has shown an extraordinary reduction in cost of current per kilowatt hour by the use of direct-connected machinery, but the units are from 500 to 1,500 kilowatts.

A fair estimate of the added saving in the use of direct-connected apparatus would be a 100 kilowatt machine, 10 per cent.; 200, 20 per cent.; 300, 30 per cent.; 500, 40 per cent.; 1,000 50 per cent.

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In buying arc apparatus the speed and weight should also govern in nearly the same degree the price of the largest size you can use. The pressure which reaches 6,500 volts in 125 light arc dynamo seems to be carried on the ordinary arc circuit as easily as 3,000 volts. Of course, 6,000 volts will jump nearly twice as far, and theoretically would require twice the insulation to hold but experience has shown that if an overhead arc line is built to protect a pressure of 3,000 volts, it will carry 6,000 volts with safety. No reliance whatever is placed upon the insulation of the ordinary No. 6 overhead arc line, which should be erected as if the wire was bare, as almost all such lines five years after erection are bare so far as insulating qualities are concerned. The weak spots requiring increased insulation are the wires from the pole to the lamp or entering stores. Beginning then at the pole, these wires should be a high-grade rubber insulation. The regular weatherproof line wire will give constant trouble even when protected with porcelain or hard rubber bushings or flexible tubing. It is not necessary to use rubber insulation throughout your overhead arc line, even with 150 light arc machines.

When the purchaser comes to buy alternating apparatus he is confronted with single-phase, quarter-phase, two-phase, three-phase, multiphase, and moncyclic—surely enough to feaze him to start with.

But what system will fit his conditions? What machine should he buy?

With the use of an efficient motor the single-phase is the ideal alternating current system, No condensers, no balancing of the load, no fixed arbitrary line loss, but two wires on the line, all giving a flexibility that affords a minimum cost in power, arc and incandescent services from the same machine and circuit.

All the catalogues of multiphase apparatus contain statements variously expressed, that a single-phase synchronous motor is the most desirable but unattainable type. This is no longer true as to its unattainability. Single-phase motors are now sold on the market, having as high a commercial efficiency as is obtained in any but the large types. They are self-starting at full load with maximum torque. They require no special circuits or connections, no starting rheostat, no condenser and no special transformer, the ordinary lighting transformer answering the purpose. Being in step with the generator, the regulation of the synchronous motor is perfect under all loads, and the motor will pull out of step and stop running if more than a 50 per cent. overload is applied.

What is a single-phase dynamo? It is a machine wherein the number of coils in the armature equal the number of pole pieces in the field. The armature coils have the same "pitch" as the pole pieces. The "pitch" is the distance from the center of one field pole to the center of the next. The coils are connected so that the armature contains but one circuit or ring of coils.

The two-phase dynamo means that there are twice the number of coils in the armature that there are poles in the field, having half the pitch of the pole pieces, The armature is split in two and instead of every coil being connected on one circuit, every other coil is connected together, so that the armature presents two independent circuits on rings or coils. It is practically two armatures in one field, each having its separate circuit for service.

Lamps may be tapped from either circuit, and one-half the armature may be cut out and the other half run on a single-phase; but all four wires comprise the power circuit and must be connected to each motor. This means four wires throughout on your poles. Both circuits may be tapped indiscriminately for light and power, but in doing so they require the same hand regulation at the station to constantly balance the load that is usually given the three-wire direct current system. Two legs of the circuit may be one wire of a nearly equal cross-section, so that the three wires require prretically as much copper as the four.

In the three-phase dynamo the armature coils are three times the number of poles and represents three separate circuits or rings of armature coils having one-third the "pitch" of the pole pieces. The number of phases by reducing the line of induction especially fit the three-phase system for the transmission of very large powers over very long distances, and the current may be delivered on not less than three and as many as six wires, depending on the fluctuations and proportioning of the load in the different services.

Monocyclic is different only in the method of connecting and proportioning the armature coils and is to all intents and purposes an unbalanced three-phase machine, unless we assume that the placing of the teaser coil in the middle of the main coil of the armature does not split these coils in two, in which case it becomes an unbalanced two-phase machine, as the teaser coil, while having wire of the same cross section is but one-fourth the size of the main coil. The armature coils equal the number of pole pieces and are of the same "pitch," and the teaser coils, being wound in the opposite direction, are connected one end to the middle of the main coil circuit, the other end to the third collector ring, making a three-wire circuit, this arrangement being slightly modified to include a commutator for compounding the field to compensate for line loss.

When the dynamo is intended for lighting service only, the third wire may be dispensed with and the machine run as an ordinary single-phase machine, but with a consequent reduction in efficiency caused by the idle teaser coils.

When the dynamo is intended for power only, the three line wires must be of the same cross-section and all three wires must be in service.

When power and light are both run, the so-called teaser line wire only can be reduced in proportion to the power service, although the full cross-section of wire is usually advocated.

A quarter-phase dynamo is a two-phase machine with the coils set one-fourth or 90 degrees ahead of each other.

You are all familiar with the difference of cost in erecting and maintaining two or more circuits instead of one, or three wires instead of two; but some buyers neglect the consideration of this expense until their multiphase apparatus is purchased, when it confronts them with the nasty familiarity of the unexpected expenditure so usual in disbursing our wonderfully overestimated receipts.

Again at least one two-phase system advocates limiting the loss on line copper to two per cent.; the alternative of having a greater line loss with a small expenditure of cash for copper is a reduction in the efficiency of the service and usually the use of condensers, It is Hobson's choice as to the amount of money required, though you might get time on apparatus, while copper is cash.

The phase affects the units in which your power is distributed. Impedance, lag and idle currents develop as the size of the self-exciting motors increase, practically limiting the distribution of power on a single-phase circuit to motors not exceeding in size 100 horse power.

The single-phase generator may be a 1,000 horse power machine, but any one of the motors must not be larger than 100 horse power unless independently excited and started.

So far as the phases are concerned, the only conditions under which a multiphase system is more applicable than a single-phase is in the transmission of very large amounts of power over great distances, and where the power is distributed in several units.

After the phases the important consideration is the number of alternations or the frequency.

The market apparatus of various makes gives 16,800, 15,000 and 7,200 alternations, or the product of the number of poles multiplied by the speed per minute.

An alternation is the traveling of a current through the circuit in one direction: and when it has completed its journey in the opposite direction it has made a complete period or cycle. Two alternations make a cycle; hence 16,800 alternations per minute is 8,400 cycles per minute, or 140 cycles per second; 15,000 alternations per minute, 125 cycles per second, and 7,200 alternations per minute, 60 cycles per second.

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Why do different manufacturers make machines and transformers with different phases and alternations? First, the opinion is offered that it is to have something new, implying an improvement to talk up and advertise; something different to that which the other fellow sells. Secondly, because low frequency machines are cheaper to build. Thirdly, because different frequencies affect in different degrees the power, incandescent and arc services.

Generally speaking, the higher the frequency the better the lighting service. The frequency of 3,600 alternations per minute, or 30 cycles per second, is suitable for power only and will not commercially operate an arc or incandescent service at all; because the low period current waves produce an undulating and decidedly fluctuating light.

Power is practically limited beteen 20 and 150 cycles per second, or 2,400 and 18,000 alternations per minute, because lower frequencies reduce the speed and increase the weight of motors and transformers beyond a commercial economy, while higher frequencies mechanically prevent getting the necessary number of pole pieces within an efficient compass or radius.

In the alternating arc lamp the high frequency makes an audible hum, with a distinct "pitch" of tone more or less musical; the low frequency reduces this tone "pitch" and increases the volume with but a little lessened Wagnerian effect. This noise is partially eliminated by using a special transformer or arc service only.

There is a special arc transformer on the market that will feed a steady current through the ordinary $7 carbon, dispensing with the $20 to $30 cored carbon and reducing the cost of carbons $7 per year in the single carbon, and $14 per year in the double carbon lamp, giving an equally good service without the use of resistance or economizing coils with their corresponding waste of energy.

Running any make of alternating arc lamp from the incandescent transformer has not yet produced a competitive arc service, and applying the known results to the plants represented in this association, the application would resolve itself into the use of the regular arc dynamo and lamp where the number of lamps exceed forty. When an alternating station has an output of a few arc lamps, by all means use the alternating arc with a special transformer permitting the use of the ordinary carbon, but when you can sell more than forty arc lamps the saving of the current lost in conversion and the single wire circuit of the regular arc system must then commend itself.

The alternations also affect the ordinary transformer. But two makers to my knowledge build a transformer especially for 7,200 alternations. All the other manufacturers build a transformer designed for high frequencies, and without altering the patterns or construction beyond a few trivial changes to make room for the necessary added ampere-turns of wire, offer a transformer presumably suitable for any frequency.

How does this affect the man who buys transformers? If he has a high frequency current, this type of transformer will consume 50 per cent. more magnetizing current than one designed only for high frequency.

If he applies the high frequency transformer to the low frequency current, the lack of necessary ampere-turns of wire or weight in iron makes the loss in magnetizing current still greater and the transformer mighty hot.

The quick repair transformer, wherein the iron field is split in two so the coils can be readily replaced, is too dear at any price, the broken magnetic circuit causing too great a loss of current in energizing the transformer, apart from the charring of the insulation by the excessive heat generated.

It is an apt illustration of the eternal fitness of things that the electrical apparatus built to repair easily soon developes a determined disposition to accommodate you.

Summing up the brief opinions offered might suggest to the members of this association who are probable buyers of new apparatus.

First—If the amount and valuation of your money will permit, buy direct-connected apparatus.

Second—If your means or present arrangement of power suggests the purchase of belt, driven dynamos, buy the heaviest slow-speed machine of the largest capacity practicable.

Third—Use 2½ watt lamps; two watt if you can buy them

Fourth—If your power service is in small motors, none of which are larger than 50 horse power, use single-phase apparatus; if in motors larger than 50 horse power, use multiphase.

Fifth—If the proportion of lights is greater than power, buy high frequency apparatus; if power is the most important service, buy low frequency.

Sixth—Use the largest transformer practicable having the best regulation consistent with minimum loss on no load.

Seventh—Sell all your current through meter and check up the station output with your receipts.

These suggestions, numerically arranged, like the commandments, will not be taken, I trust, as advice. Advice is the cheapest thing I know of, and I value my opinions too highly to offer them to any but those who choose to entertain them.

"ALL BRITISH" TELEGRAPH SERVICE.

The London Times agitates, in a recent issue as follows:

"At the moment we are all of us painfully anxious for prompt and unadulterated telegraphic news from South Africa, from Venezuela, and from other places where there is trouble. Still greater would be our anxiety and our need in time of actual war. The public will do well to bear in mind the present condition of our telegraphic connections.

"In regard to South Africa, the Aden-Zanzibar cable happens to have broken at an inopportune moment; considerable delay occurs on the West Coast route. But all these messages, as well as those to and from the Ashantee expedition, have to pass through foreign territory.

"Again telegraphic connections with British Guiana, with all our Western Indian possessions, with our fleet in the West Indies, is maintained by means of land lines across Cuba and across the United States, lines subject to the necessities of local combatants or others who might be hostile to us.

"The remedy is simple—viz., to hasten the inevitable completion of two projected all-British direct cables. It is an axiom of to-day that submarine cables made and laid with all the latest appliances, are certain to pay for commercial purposes; for state and strategic purposes they are indispensable.

"It is therefore to be hoped that in these moments of stress the public will read the lesson aright and see to it that the responsible authorities arrange to provide the two lines of cable communication which our empire may so urgently need in the future—viz., the shorter line from Bermuda to Jamaica and the longer line from Vancouver to Australia, with its continuation to Mauritius and South Africa.

"We shall thus obtain alternative and all-British means of communicating between all oversea points of the empire, invaluable alike for the commerce and security of all its parts."

ELECTRIC LIGHT IN GERMANY.

The rapid extension of incandescent gas lighting during the past two years, its comparative cheapness and high degree of brilliancy, added to the now demonstrated possibility of changing its tints by varying the combination of oxides in the incandescent mantles, have combined to check somewhat the adoption of electric lighting in Germany, and to force electrical companies to seek new outlets for their energy in the directions of motive power and electrolysis. The central electrical system established at Frankfort a few months ago has proven technically successful, but private consumers generally complain of its high cost, and it is already evident that the financial success of the enterprise will depend in future upon the more general adoption of electricity for motive and electro-chemical purposes.

—*Extract from Recent Consular Report.*

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

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THE NATIONAL SCHOOL OF ELECTRICITY.

News and Notes of Classes and Students. Personal and Pertinent.

At the Chicago Laboratory a new feature has been added which has thus far met with the widest approval, not only from the students, but from numerous visitors.

At stated intervals, about every ten days, lectures in the form of practical talks by practical men to practical men, are given in the lecture room of the Laboratory. That this is a popular feature of the school is evidenced by the fact that at the these talks given thus far, the capacity of the Lecture Room has been tested to the utmost, not only were the laboratory students present, but many brought friends who were interested in the subjects presented, and only praise could be heard after the talks were finished.

On January 14th, Mr. Charles Locke Etheridge told of the "Work of the Electrical Engineering Department of the World's Fair," and gave a masterly exposition of the details of that remarkable work.

On January 20th, Mr. J. Glen Wray treated of the subject, "Laboratory Practice and the Use and Abuse of Instruments."

On January 29th, Mr. W. H. Crumb, chief instructor of the Laboratory spoke on the subject, "Methods of Testing Street Railway Apparatus."

The management would be pleased to have all those interested in such subjects attend these talks which although, in a way, informal undoubtedly present in a clear and logical way their various subjects. Any one interested can, by calling at the office of the school, secure full information as to the subjects and dates for future lectures.

FIND OUT FOR YOURSELF.

We would like to quote a paragraph from Herbert Spencer for the benefit of those students who are disposed to ask questions before they attempt to find the answer for themselves:

"In education the process of self-development should be encouraged to the fullest extent. Children should be led to make their own investigations, and to draw their own inferences. They should be told as little as possible, and induced to discover as much as possible. Humanity has progressed solely by self instruction; and that to achieve the best results each mind must progress somewhat after the same fashion, is continually proved by the marked success of self-made men."

BOUND LESSONS.

Students of the National School of Electricity will find in the hands of some of the members of each class the lately revised and bound lesson leaves of the general course. This volume may be safely assumed to contain the latest revision of the subjects of which it treats. It comprises the whole of the course which has heretofore been in 45 chapters or lessons. The number is reduced in the volume to 35. It is furnished with a comprehensive index and table of contents. It is bound in silk cloth, is durable, of convenient size and will be found of considerable advantage for purposes of reference in its present form. Students may ask instructors to show them a copy if they have difficulty in finding one in other hands.

It has been determined by the management to furnish this volume to students of the school only. It will be sent to those of record on receipt of the price, $1.50, either in stamps, money or express order, or check.

Others than members of the school classes will kindly not send for the book, as the reasons why its sales to outsiders is prohibited have seemed sufficient to demand an unvariable rule in this regard.

HIS SERVICES APPRECIATED.

The New York class on January 1st, showed its appreciation of its instructor, Prof. Newton Harrison, by presenting him with a handsome scarf pin. It is gratifying to the management of the school to know that its instructors are worthy of appreciation.

The laboratory in Chicago is being rapidly filled up with a class of bright and interested students. Only a few more vacancies are left at present.

AMERICAN INSTITUTE MEETING.

The 102nd meeting of the Institute was held on Wednesday evening, January 22nd, at No. 12 West 31st street, New York City, 150 members being present. Mr. Frank J. Sprague read a paper on "Electric Elevators, with Detailed Descriptions of Special Types," and illustrated same with numerous lantern projections and a working model of the essential parts. Owing to the lateness of the hour but three members, Messrs. Steinmetz, Hill and Leonard participated in the discussion which was postponed to a later meeting.

At a meeting of the council in the afternoon, the following Associate members were elected: E. B. Cunningham, Fort Dodge, Ia.; C. L. Edgar, Boston, Mass.; Edward A. Evans, Quebec, Can.; W. S. Franklin, Ames, Ia.; Walter L. Githens, Chicago; Tijima Zentaro, St. Louis; Charles Lemon, Palmerston, North, New Zealand; John E. Lloyd, Philadelphia; Wm. E. Moore, Augusta, Ga.; Geo. P. Nichols, Chicago; Wm. Bancroft Potter, Schenectady, N. Y.; Edward Andrews Wagner, Coahuila, Mexico.

The following Associate Members were transferred to full membership: Harry Bottomley, Marlboro, Mass.; Geo. W. Gardanier, New York; Fred A. Scheffler, New York; Harvey Stuart Chase, New York; Ralph D. Mershon, Pittsburg; Norman T. Wilcox, Seneca Falls, N. Y.; Lieut. Samuel Reber, Washington; Francis Jehl, New York.

A NOVEL TROLLEY LINE.

The engineers of the Marquette Iron Range railroad are considering a scheme for utilizing the power of a loaded train going down grade. It is proposed to string a trolley line over the tracks, which fall 800 feet in a distance of fifteen miles. The loaded ore cars, each carrying twenty-five tons, will be made up into trains of ten cars each, and to each train a motor car will be attached. On this car a dynamo will be placed, connected with the axles of the car. The descending train will generate electricity, which will be transferred to the trolley line and used for power by the motor car of the ascending train, which will haul back the empty cars. It is said that the difference in weight between the light and loaded cars will make up for the loss of power due to friction and leakage.

ELECTRIC TOWAGE.

Mr. George W. Aldridge, Superintendent of Public Works, for the State of New York, in his annual report, states that he is very sanguine that the electrical propulsion of canal boats is not only possible, but that the devices which have already been tested and which are being constantly improved, will result in a short time in a perfect system. The results of the test of the Lamb system, embodied in a special report from Mr. C. R. Barnes, electrician in charge of the tests, is presented in full in this report with tables showing the results obtained.

AWARDS FOR WESTINGHOUSE.

The Westinghouse Electric & Manufacturing Company of Pittsburgh has received a number of awards at the Atlanta Exposition for the handsome exhibit of electrical apparatus made. Several gold and silver medals are among them.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

On January 1st the rate for telephone messages in Paris was reduced from 50 centimes to 25 centimes, or in United States money from 10 cents to 5 cents, for a five minute conversation. From Paris as a center within a radius of 25 kilometers the rate is 5 cents for a three minute talk, and for distances from 25 to 100 kilometers the rate is 10 cents for each five minutes. For greater distances the tariff increases at the rate of 10 cents for each 100 kilometers or fraction thereof.

The Western Union Telegraph Co. is making an effort to secure a franchise for an individual underground conduit system for its wires in Kansas City. There is some friction between the company and the city council on the subject of the annual compensation to be paid for the privilege, but this is now in course of adjustment.

Wire Commissioner Murphy, of Boston, reports that in 1895 accommodations for putting 11,000,000 feet of wire underground were provided in that city. During the year 554,400 feet of conduit were put down and 898,000 feet of cable placed. It is expected that during the current year about 15,000,000 feet of wire will be similarly disposed of.

Mr. J. J. Storrow, leading counsel of the American Bell Telephone Co., is to take a trip south to regain his broken health.

Eagle River, Wis., has just been equipped with a fire alarm telegraph system.

Light and Power.

PITTSBURG REDUCTION COMPANY'S INCREASE.

The Pittsburgh Reduction Co. of Niagara Falls has found it necessary to increase its electric plant owing to an increase in its reduction plant. Hitherto four of the General Electric 400 K. W. rotary converters have been in use, but they have been found inadequate to the service demanded of them and will be replaced with four of 600 K. W. capacity each. As these will be mounted in the same base frame occupied by the discarded machines, a considerably increased capacity will be obtained without additional floor space. In addition, a fifth 600 K. W. converter will be installed, thus giving the plant a converter capacity of 3,000 K. W.

The Committee on Water Works and Public Lighting of the Board of Public Improvements of the city of St. Louis has drafted an ordinance giving the Board authority to advertise for proposals for lighting by electricity the streets and alleys in that portion of the city north of Keokuk street for a term of 30 years, and that portion of the city south of Keokuk street for a term of 25 years from Jan. 1st, 1900. It is expected that competition will be keen to secure these exceptionally long term contracts with manifest advantage to the public.

The Western Electric Light and Heat Company are commencing the construction of their system at Vancouver, B. C. Sixteen thousand poles are on their way there. The power house will be built on False creek. The new company will supply light to private citizens at half a cent per ampere hour. An ampere hour is described by the company as 48 volts supplying a 16-candle power lamp for 60 minutes. The power in the main wire is 2200 volts, while in the wire that enters private houses is reduced to 48 volts.

The Edison Electric Illuminating Co. of Baltimore has submitted two propositions to the mayor of that city agreeing to put its wires underground in the heart of the city. One proposition provided for a general subway with space to rent to all other wire using companies. The other proposition dealt with the wires of the Edison Co. only, and a readiness was expressed to commence work at once.

In accordance with the idea that the water power of the mountains on the Pacific slope can be readily utilized for generating electricity for long distance transmission, a second company has been formed at Fresno, Cal., to locate a plant on Kings River. The Kings River Electric Power Co., with a capital of $350,000, will transmit power to Reedley, Sanger, Danube, Visalia, and other points in that vicinity.

Notwithstanding the objections of those who insist on a rigid observance of the Sabbath even at the expense of public convenience and comfort, the Board of Police has granted the Boston Electric Light Co. permission to prosecute the work of laying its underground cable on Sundays, thereby reducing the inconvenience to the public and the company to a minimum.

Detroit has reason to be proud of its municipal lighting plant. The secretary of the public lighting plant has prepared a report which shows that for the three months ending December 31st, a saving of nearly $17,000 had been made to the city over the cost of the former contract lighting.

At Logansport, Ind., the city authorities have effected a saving of $15,000 in one year by abandoning the contract system of lighting for a municipal plant. There are 155 lights in service, the entire cost of which is covered by the sale of current to private parties.

Mr. M. Gottfried has equipped his country seat known as "Villa Gottfried" at Elkhart Lake, Wis., with a 500 light storage battery plant and a 4 H. P. electric launch equipment. Mr. Charles G. Armstrong, of this city, acted as expert in this installation.

The entire press of Utica, N. Y., is unanimous in its demand for municipal ownership of the plant for city electric lighting. The examples of Chicago, Elgin, Ill., Fairfield, Iowa, and other cities are being held up for public approval.

The electric light plant at Chamberlain, S. D., which commenced operations on the 18th inst., is novel in that it derives its hydraulic power from a flowing artesian well.

The commission to prepare the new charter for the city of Seattle, Wash., is endeavoring to provide for municipal ownership of gas, water, electric railway and telephone plants.

Walpello, Iowa, is to have a lighting plant. The Walpello Electric Light and Power Co. has been organized by W. H. Prescott, W. S. Isett, L. A. Reily and others.

An ordinance providing for a Municipal Electric Wire Inspector has been introduced into the city council of St. Paul, Minn., and will undoubtedly become a law.

Topeka, Kan., is to have a municipal electric light plant with a capacity for 300 arc lights. Bids for furnishing about $14,000 worth of material have been asked for.

The city council of Keokuk, Iowa, is preparing to advertise for proposals to furnish 140 arc lights for city purposes, the contract to run for 5 years.

The city authorities of Toronto, Canada, are seriously considering the advisability of establishing an isolated electric plant for the city hall.

The electric light plant at New Castle, Pa., was completed and began operations on the 25th inst. The plant cost $120,000.

The electric light plant at Bronson, Mich., was completed and put in operation on the 18th inst.

The Fall River Electric Co. and the Edison Light Co. of Fall River, Mass., are to be consolidated.

The new electric light plant at Holton, Kan., was put in operation on the 15th inst.

Articles of incorporation for the Acme Street Lighting Co. have been filed in St. Paul.

The new electric light plant at Bronson, Mich., was put in service on the 25th inst.

St. Joseph, Mich., contemplates establishing a municipal lighting plant.

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Railways.

The officers of the Metropolitan Cable Railway system of Kansas City have secured the services of Mr. James R. Chapman, of Chicago, as electrical expert, and are consulting with him as to the advisability of replacing the steam machinery in their various power houses with motors to be supplied with current from the central electric station.

The Chicago and Englewood Street Railway Co, it is reported, will use a storage battery power equipment and have practically closed a contract with the Electric Storage Battery Company for the material necessary to equip fifty cars. This is the largest storage battery equipment ever purchased by a single corporation.

The Akron, Bedford and Cleveland Electric Railway is 28 miles long and is operated by two power houses, 18 miles apart, one being situated at Bedford, the other at Cuyahoga Falls.

The overhead trolley has received a decided backset in Belgium, the Ministry of Railways having refused to permit the erection of trolley lines in Brussels.

General News.

GENERAL ELECTRIC REMOVAL RUMORS.

The Press of Utica, N. Y., is responsible for the statement that the General Electric Company is contemplating a removal of its works from Schenectady to Roselle, N. J. Inducements in the way of $1,500,000 have been offered, to be paid as follows: $250,000 when the contract is signed, $1,000,000 for new buildings, and the remaining $250,000 upon the removal of the plant. Camden, Pa., is in the field also with an offer of $500,000 for the removal of the plant to that place.

The Crocker-Wheeler Electric Co., whose works at Ampere Station, N. J., were destroyed by fire on April 7, 1895, completed its new works and resumed operation on January 15. All machinery in the new plant is operated by independent motors supplied from a central station, thus entirely doing away with line shafting and belting. The American Society of Civil Engineers visited the works in a body on the 16th inst.

The American Engineer and Railroad Journal and the National Car and Locomotive Builder have been consolidated under the title of American Engineer, Car Builder and Railroad Journal. It will be under the editorial supervision of Mr. M. N. Forney, assisted by Mr. Waldo H. Marshall, heretofore editor of the Railway Master Mechanic, of Chicago, and will be published monthly.

The 102nd. meeting of the American Institute of Electrical Engineers was held in New York on the evening of January 22nd. Mr. Frank J. Sprague presented a paper entitled "Electric Elevators; Their Uses and Advantages," illustrated with lantern slides.

M. M. Henri Moissan and Arsene D'Arsonval have been made officers of the Legion of Honor.

ELECTRICITY IN ST. LOUIS.

City Lighting Superintendent O'Reilly Tells the City's Record for the Year in Matters of Railways, Light, and Electrical Casualties.

Mr. A. J. O'Reilly, superintendent of the lighting department of St. Louis, has just submitted an interesting annual report to the Board of Public Improvements. The report goes into electrical matters somewhat outside the lighting and presents a most excellent summary of what St. Louis is to-day electrically. There are 251 miles of electric railway in the city operated by 22 distinct companies, 32 miles of cable road and a mile and a half of horse road, which is to be electric this spring. The city is lighted by 2,000 arc lamps mostly at street intersections, and by 3,000 incandescent lamps mostly used for alley lighting. The cost of lighting has decreased from $318,043.61 in 1890 to $262,608.34 in 1895. The report fails to state whether the decrease is due to less light or lower prices. The contract prices for light vary from $74.95 per 2,000 c. p. arc lamps for all night lighting to $39.90 for the same lighting from sunset to midnight.

An interesting part of the report is that concerning accidents. The comparative danger between gas and electricity is suggestive, and will do much to stop the unreasonable howl on the part of the daily press against the "deadly wire." There were four persons killed by contact with electric wires and one killed by a fall from pole after shock. Against this record there were ten persons killed by asphyxiation from illuminating gas. Only two fires were caused during the year by electrie wires.

GETTING UNDERGROUND.

The Philadelphia Record prints the following interesting item:

Owing to the fact that no appropriation is this year provided for extensions or improvements in the Bureau of Electricity, no extension of the city's underground electric light service is anticipated. The service of the Brush Electric Light Company, in the centre of the city, is being put underground as fast as possible. On Market street the conduits are already laid, and similar work is now progressing on Chestnut street.

The underground cable for the public lamps on Chestnut street will soon be in operation, thus permitting the removal of three overhead wires, and, as fast as they can be put underground and connections made, the remainder of the company's fourteen wires on Chestnut street will be removed, and only the poles supporting the public lamps will remain, thus clearing Chestnut street of all poles except the lamp and trolley poles. This underground work will continue until all Brush overhead wires are removed in the district, embracing Spruce, Walnut, Chestnut, Market, Arch, Race and Vine streets.

THE MOTOR VEHICLE.

The Horseless Age of New York, which is the organ of the motor vehicle in this country, has recently sent out a circular to manufacturers and others asking for *definite* information—facts and figures—concerning improved mechanism for motor vehicle work.

Editor E. P. Ingersoll says in his circular: "Up to the present time there has been a lack of definiteness in the information given by most inventors; we propose, from this time forth, to give less space to general claims unsupported by facts or demonstration."

If The Horseless Age will adhere to this plan, it will do much for the interests of the motor vehicle. Some manufacturers have been close followers of the late lamented Baron Munchausen, and while we are fond of fiction we do not like it mixed with science or the industries.

RAILWAY EMERGENCIES.

Mr. L. F. Loree, M. Am. Soc. C. E., has written a paper on "Emergencies in Railroad Work" which is published in the engineering series of the Bulletin of the University of Wisconsin, after having been delivered as a lecture before the engineering classes.

The emergencies dealt with are wrecks, washouts and strikes, and a full description of the tools which must always be ready to meet the two first and the most effective methods of dealing with them are fully set forth and modern instances and appliances are fully described. The late railway riots in Chicago are explained and the methods adopted by the railway companies to protect themselves and keep their tracks clear are lucidly described.

DEATH OF ALFRED E. BEACH.

Alfred E. Beach, for 50 years active in the editorship of the Scientific American, died of pneumonia at his home in New York city on January 1. He leaves a widow, a son and a daughter.

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THE MOTORMAN AND HIS CAR.*

Tells of the Knowledge Required, His Responsibilities, Cares and Duties. Some Plain Facts, Clearly Stated, as to the Management of Electric Cars.

MARRIED MEN ARE BEST FOR THE POSITION.

The great factor of success in any pursuit of life, is "a sound mind in a sound body." This is especially true with reference to the occupation of a street railway motorman, where mind and body are both under severe and constant strain. From the moment a conscientious motorman steps on his car, until he steps off, this strain upon him is not relaxed. Such being the case, we can readily understand how essential it is for him to be endowed with a mind and body capable of great endurance. Essential, and for a motorman absolutely necessary accompaniments, are a cool head and steady nerves, with eye and ear perfect. Among the qualities which a motorman is most called upon to exercise are judgment and prudence; just so long as there are in this world careless men and women and thoughtless children those two qualities will stand him in good stead.

Were I called upon to instruct a motorman on any one particular point, I would say to him: "Be prudent; take no risks; do not depend upon people to look out for themselves" A motorman should be temperate. This requisite I consider of the first importance. It is as it were, the corner stone of all the others. The electric cars are a great convenience to the public; they are in fact a necessity. When handled properly they contribute to the public good, but when in the hands of incompetent men, they become a destructive force. Who, of all men, so incompetent, so incapable, as a man under the influence of liquor of any kind. If a motorman, in the possession of all his faculties, with his senses keenly on the alert, cannot avoid mistakes and accidents, what can be expected of a man whose senses are dulled by drink, whose judgment is impaired, and whose prudence is thrown to the winds.

There is another requisite, not so important as those already mentioned, but if a motorman has it, and not only has it but uses it, will go far towards lessening the little annoyance that he may meet with during the day. This requisite is good nature. It comes particularly in play when teamsters make it a point of getting in the way of the car, and obstinately persist in staying there. Good nature and pleasant words will do more towards inducing these teamsters to relinquish their position than angry words and profane language. As a rule, "molasses captures more flies than does vinegar."

Another question is, "What is necessary for a motorman to know regarding the motor, rheostat, controller, switch, fuses, wiring, etc?" In order to render good and efficient service, it is necessary for a motorman to know all that he possibly can regarding these different parts. He cannot be too well informed upon them. Under favorable conditions a motorman may be able to run a car, having but very little knowledge of its mechanism. But, unfortunately, conditions are not always favorable and, sooner or later, there comes a time to the poorly instructed motorman, when he has reason to regret his lack of knowledge.

First of all, a motorman should realize that the power that moves the car is a strong electric current; that the car now traveling so swiftly and easily, moving as it were "like a thing of life," is but a cumbersome load until charged by this powerful and mysterious agent. The electric current is conveyed from the generators all over the different lines in the city through large insulated feed wires. These feed wires are connected at different intervals to the trolley wires along the different lines. The current reaches the car through the medium of the trolley and trolley pole. The trolley pole is attached to an iron base on the top of the car. At this base the wiring of the car begins. The wire then goes to the hood switch, and from there to the fuse box and thence to the contact board, to the rheostat and thence back to the contact board and from the contact board to the cut out switch, thence to the armatures, from the armatures to the terminal box and thence to the reverse switch, and from the reverse swith to the terminal box, thence to the field magnets and back to the terminal box, to the reverse switch and from the reverse switch to the motor frame. This ends the wiring of the car. The current passes through the motor frame to the wheels; from the wheels to the rail and the ground wire and back to the power station. This completes the circuit. The hood switch is used to cut the current out in case anything becomes out of order in the operation of the motors. A motorman should not attempt to make any repairs without first turning off the current.

A motorman should never leave his car at any time or place without first throwing the hood switch; for electricity is not unlike a hungry dog in a meat market—not to be trusted. The fuse box is used to protect the motor. In the fuse box the wire is cut and about six inches taken off. The ends are then connected to two terminals. These are about six inches apart, and are connected by a fuse wire. The fuse wire is only about one-fourth the size of the wire used in wiring the motors. If anything abnormal happens in the operation of the motors, the fuse, being the weakest point, will be the first to give out. This will save the motors, as they will then be out of commission until again connected by another fuse wire. There are many things that may happen which will cause a fuse to burn out. Poorly connected terminals will cause an arc, and the arc will burn out the fuse. Anything that causes an arc will burn a fuse, such as a grounded armature, a short-circuited armature, a grounded field magnet, a short-circuited field magnet, an open circuited field magnet, a short-circuited reverse switch, a short-circuited rheostat or a short-circuited contact board. All these things will cause an arc and burn out a fuse.

A mortoman in crowding his car in starting, will burn out a fuse. Motors are injured a great deal by motormen using poor judgment in starting. A motorman should use great caution in putting on the power, for the rheostat is connected with the contact board and as the contact board is a feeder to the rheostat, the current should be turned on very slowly in order to use the rheostat properly, as the rheostat acts as resistance to control the flow of the current. The rheostat is in sections and every proper move that is made with the controller cuts off a section of the rheostat, so that when the last move is made with the controller the power is all on, the resistance is entirely cut out, and the current goes direct from the trolley wire through the motor and back to the power house; or at least a part of it goes back.

The reverse switch is used to change the course of the current, so as to run a car in the opposite direction. The change is made through the magnets. The field magnets are two large coils of insulated wire around soft iron cores. Each motor has two poles known as the North and South pole. The poles attract the armature, and the armature being connected with the axle it starts the car in motion. The positive wires at the commutator are always the same, no matter in what direction the car is going. Every car has two motors and each motor has a cut-out switch. If anything happens to one of the motors, and the motorman cannot repair it, all he has to do is to cut out that motor with the cut-out switch, and by being careful the other motor will bring the car to the station all right.

The armature is connected with the axle by gears, and in going around sharp curves the inside wheel is forced to slip or "kick" back, as the outside wheel has a greater distance to travel, and the gears are therefore liable to be partly thrown out of mesh. Then the strain will come on the corners of the teeth, and in this way a great many gears are stripped. When a motorman is obliged to use the power in going around a curve, he should always cut it off again before he leaves the curve and let the car drift until it comes on to the straight track again, as this gives the gears an opportunity to get back to their proper bearings. While the power is on, the gears are working so hard that they cannot get back to their proper place. The inside rail of a

* By M. J. Ryan in *The Station*, (Rochester), January Number.

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curve should never be sanded, in fact it should rather be oiled, so that the wheels will slip easily.

When a motorman is obliged to reverse his car to avoid an accident, the brake should not be used at the same time, as it would prevent the wheels from turning in the opposite direction. On a good wet or dry rail the reverse should always be used to prevent an accident. On a rail that is partly wet or greasy use the brakes, for they are the best. On a good rail a car can be stopped almost instantly by using the reverse; that is after the power has been applied and three-fifths of the resistance cut out. Three-fifths of the resistance has to be cut out before the wheels will turn in the opposite direction. When the reverse is used on a slippery rail, the wheels are locked almost instantly, and the weight and momentum will send a car ahead faster than it was going before the current was reversed. When the car slides like this, keep putting on the power until the wheels begin to turn again. As soon as the wheels begin to turn, then cut off the power and use the brakes, handling the brake very easily so that it does not pull too quickly and hard; if it does the wheels will start sliding again. Always keep in mind the kind of rail that you are running on.

Never spare your car when there is anything at stake. Use reverse, brake and sand, leaving nothing undone. If you injure a car in trying to prevent an accident, no matter how great the injury is to its property, the company will sustain you. It will be a mark to your credit with the management.

A motorman should never pass an overhead trolly span or guy wire that is broken and hanging down, without stopping and tying it up. It is very dangerous to allow such wires to hang, as pedestrians may come in contact with them. Great care should be exercised in handling live wires, always using a dry board to stand upon. Be sure that there are no nails in the board. While on the board and handling the wire, do not take from or hand anything to, anybody standing on the ground. Be careful about coming in contact with any conducting substance while you have hold of the wires.

While running a car at the maximum speed, a motorman should keep at least two hundred feet in front of his car clear. He should never undertake to pass a vehicle or anything drawn by horses going parallel and in the same direction, without first having attracted the attention of the driver with the gong. In passing all streets the power should be cut off and the speed of the car checked; especially when the track is laid on the side of the street.

If you wish to become a motorman you should find out what the hours are that you will have to work, what the wages are and what the rules of the company are, before putting in your application. If they are satisfactory to you put in your application. If you are fortunate enough to secure a situation give it a fair trial before you become dissatisfied with it. If, after such fair trial you do not like it, my advice is for you to walk in to the superintendent's office, turn over to that official the articles belonging to the company, and ask for your deposit: for your staying will not only injure yourself, but you will set a bad example for others. Otherwise you will ignore the rules of the company and cause it to issue more rigid rules, and we, who are satisfied with our positions, will be the ones who will have to suffer.

When I started in the street car business I was very much dissatisfied with my position in life, yet I did not allow myself to become discouraged. I persisted until I had given it a fair trial. Then I came to the conclusion that it is an all around good position for any one who is adapted to it.

I have been on the cars now nearly fourteen years, and I could tell many a pleasant story about street railroading. There are a great many temptations which we have to fight against, but a man with a strong mind and willing disposition, can resist almost anything, if God is with him. I had only passed out of my teens when I entered the employ of the street railway. I feel just as hale and hearty as I did then. I can do just as much work as then, and perhaps more. I like the business, and did almost from the first. A good way for a man to do while in the employ of the company is to live up to the rules of the company as well as he can and never violate them except in the interest of the company. A man to be a good and successful motorman, should be married. A single man does not render as good service to the traveling public as a married man. His mind is more on catching the eye of good-looking girls than it is on looking for passengers who wish to take the car. People have different ways of signaling a motorman to stop his car. Some will raise their hands or umbrellas, some will bow, some will wave their handkerchiefs and some will turn their backs and look down the track. Some ladies will bow and smile, and if the moterman is single, he will take the bow and smile as evidence that he has met another lady friend, and the car will roll along and the lady and her smile will have to wait for the next car. There is scarcely a day passes that I do not have a laugh with ladies who tell me about the other car not stopping for them.

Finally: do not lie at the end of the road.

M. J. RYAN—In *The Station*.

OCEAN DEPTHS.

Some of the difficulties of ocean cable laying may be guessed at from the following item taken from an exchange: A sounding has recently been taken in the Pacific Ocean, near the coast of Japan, which showed a depth of 29,400 feet, or approximately five and a half miles. This is a little more than the height of the loftiest mountain. How much deeper the Pacific is than this it is impossible to tell—the wire having broken, presumably through its inability to sustain its own weight. In a previous attempt to reach the floor of the ocean at this spot, the wire broke at the depth of 25,800 feet. It has been suggested as one theory of the formation of mountain ranges, that they represent the crumpling up, or buckling, of the earth's crust under the severe contraction strains that were set up as the surface of the globe solidified. If this be true, the deep ocean valleys or gorges, such as this off the coast of Japan, must be the result of the same action. Taken in connection with the loftiest mountain, this sounding gives a difference in distance from the earth's center of about twelve miles, or $\frac{1}{3\,3\,3}$ of the earth's radius.

A NEW PHOTOMETER.

Prof. Minchin has succeeded in producing an improved form of selenium cell, so sensitive that it shows a measureable deflection on the electrometer when the light of a star is concentrated on it by a teloscope. The improvement in this cell consists in preventing contact between the liquid cell and the aluminium wire used, by the employment of a glass-inclosing tube, and the consequent prevention of local currents and leakage. When the instrument is used for measuring the relative "magnitudes" of stars, the results were found to coincide very closely with those obtained by the photometric method. If the distance of a star is known, its intrinsic energy, the quantity of energy which it radiates into all space can be determined by this instrument. Prof. Minchin has measured the electro-motive force of the lights of Jupiter, Saturn, Vega, Arcturus, Regulus, Procyon and some other stars. The light of Vega, concentrated by a two-foot reflector, gave a slightly greater deflection than the light of a candle placed at a distance of nine feet.

STANDARD RULES FOR ELECTRICAL CONSTRUCTION.

The meeting of representatives from the American Institute of Electrical Engineers, the National Board of Fire Underwriters, the American Bell Telephone Company, the Western Union Telegraph Company, the Postal Telegraph Company, the General Electric Company, the Westinghouse Electric and Manufacturing Company, American Street Railway Association, the International Fire Chiefs' Association and the American Institute of Architects, which was called by a committee of the National Electric Light Association to meet on January 18th to formulate a standard set of rules for electrical construction, has been postponed and will meet on March 18th. Mr. W. G. Hammer, chairman, is confident of a full attendance of delegates from the above associations and firms.

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

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The Future of Electricity.

Our lay press has always been seeking some sort of electrical Utopia. Its writers seem to go on the principle that because "wonders have been accomplished" there is no limit to what may be done. Perhaps that is true. At any rate, such a stimulus is good for the workers in the electrical profession. Most lay writers, however, seem to think that because a thing is *possible* it is also *practicable*. Such a writer in the Minneapolis Times says: "Electrical power outside our cities which would do away with the present steam plants located within them, would be an advance on present methods of great importance." We are doing that very thing in the smaller towns every day, where distances are not great and conditions are not exacting, and especially where water-power—the cheapest power we have—is available. It is also being done with street railway plants. But there is a limit and the limit is fixed by dollars. No motive power and no light can be commercial unless it is able to compete with steam, or with gas and oil. Electricity has arrived at a point where it can compete in many directions and its field is constantly growing larger, due to the introduction of economics. And not the least important consideration is the fact that our electrical engineers are able to determine to a nicety the point where electricity is practical—which is another word for commercial. For instance, there are many places where electricity is generated at water power and transmitted many miles "commercially"—that is as cheap or cheaper than steam or oil or gas. But where this is true, it does not necessarily follow that electricity is *cheap*, only that it is relatively so—perhaps fuel is excessively high.

There is no question that commercial electricity is being generated and furnished cheaper and cheaper all the time as methods and means improve. And there is also no question that it will be the power of the future to move the mills and light the homes of the world. But that time will come quicker if we are temperate and do not hazard capital in dangerous places, as we did in the earlier days because of over enthusiasm and under knowledge. Let us go slow and above all let us remember that those who make the most noise are usually doing the least work—or paraphrased, those who talk the most about what electricity can do, know the least about it, and they do not furnish the "lubricator" to make the wheels turn easily.

The Static Machine in Medicine.

In another page of this issue we publish the fifteenth or last lesson of the electro-therapeutic course of the National School of Electricity. Its subject is the Static Machine in Medical Practice. The lesson is prepared, as are all the lessons of the course, by Dr. Herdman, of the University of Michigan. Many physicians are constantly using the static machine in their professional work, and a still larger number are making inquiry as to the employment of that particular form of electricity. They wish to know what has been done and what is being done. We believe very few will read the lesson presented without deriving some useful information from it. It may be added that this kind of work is being done in the electro-therapeutic department of the National School of Electricity. Fourteen other lessons like this have been prepared and are used as part of the course. These lessons are led up to by other lessons on the elementary principles of electricity so that those physicians who have not gone into the subject at all, may be prepared for the actual work to follow.

The time has passed when any member of the medical profession can ignore electricity and expect at the same time to be considered in touch with the best and most progressive element.

* * *

The Value of a Journal.

If there is any question in the mind of any one as to the relative value the electrical people—manufacturers and consumers—place on the different electrical papers, please step into an office where *all* the papers are received. Ten chances to one you will find the current periodicals piled in a heap, most of them still in their wrappers—all except THE ELECTRICAL JOURNAL, which you will find within easy reach of some one in authority and either opened or marked. If there is still a question, step into the office of THE ELECTRICAL JOURNAL any day and if for any reason the paper has failed to reach a subscriber you will be shown a reminder of that fact in the current mail. In other words, when people fail to get THE ELECTRICAL JOURNAL they write about it at once.

* * *

Foreign Cheap Labor.

Some facts of much interest to the manufacturers of this country are being discussed by the British and Japanese papers. Some time since a steam locomotive was purchased in England and shipped to Japan at a total cost £1,793. An exactly similar engine was, a little later, made in Japan from an English design, and with material mostly shipped from England, but the labor was performed by Japanese workmen. The cost of the second engine was £1,349, or £443 less than that made in England, the difference representing the difference in cost of labor. These figures are significant. They point either to the upbuilding of Japanese and subsequently Chinese home industries, or the establishment of local branches of foreign houses.

* * *

The destination of the British "Flying Squadron" has at last been ascertained. The fleet is bound for Llewellyn Park to try the efficacy of Mr. Edison's suggestions for coast defense. It is expected that the fleets of France, Germany and Italy will join in the "hunt." The editors of the electrical journals of those countries are on the bridges.

* * *

The report of City Electrician O'Reilly, of St. Louis, for the past year published in another column, should do very much to demonstrate that electricity is not the most dangerous element we have to deal with. Three people were killed by electricity and ten by gas. These figures are eloquent enough to be left to themselves.

* * *

The foreign technical journals are coming in full of red fire and blood reports: especially is this true of the British periodicals. That's all right, friends! But let us hoe our own row until the reserves are called out, then we will have a chance to be in "at the death."

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St. Louis Subway System.

After a long and hard fight, the authorities of St. Louis, Mo., have decided to "bury the wires." But the action they take to that end will not solve the problem. An ordinance has been agreed on simply compelling the owners of all overhead wires, excepting railway circuits, to place them underground. No method is specified. No system is recommended. No unanimity of action required. If the ordinance passes, which it probably will, it will mean that the telephone, telegraph and lighting companies will have to make a common cause in the shape of an underground system, or go it alone, each maintaining a separate system and incidentally a separate nuisance. St. Louis is well paved and quite up to the best in regard to the maintenance of streets. The independent laying of three or four electrical conduit systems will keep the streets torn up continuously for a couple of years at least, and at intervals thereafter.

If there ever was an excuse for an auxiliary "construction company," St. Louis is the place, and now the time. All the interests could get together, do the work at much less cost than separately, and arrangements could be made for the common use of the system, something after the scheme of employment of the bridge and tunnel by the Gould interests. This ought to be done.

* * *

The New Photographic Process.

The lay press has of late given considerable space to the alleged discoveries, by Prof. Roentgin of Wurzburg University, of a light which has enabled him to photograph certain objects through opaque substances.

At present the startling claims made through the press are entirely too widely improbable to be treated seriously, and the illustrations taken from alleged original photographs, plainly bear the impress of fraud on their face. It has been long ago demonstrated that certain opaque substances are readily transparent to certain etheric waves, longer than those of light, but it is to Hertz that the credit of this discovery belongs and not to Prof. Roentgin. It has always been supposed that these waves of light, which are longer than the red rays of the end of the spectrum, were non-actinic, but Prof. Roentgin may have invented a plate that is sensitive to these rays. That he can, or has, violated all pronounced and accepted theories and rules of optics by taking his photographs without the intervention of a lens of any kind, is something that will require the fullest investigation before acceptance. Until more positive proof is brought forward, or a full description of the new process is given, judgment as to the value of the discovery will have to be suspended.

* * *

Municipal Control.

We have heard a good many reasons advanced from time to time why electric plants should not be owned by the people. Here are some new arguments from a neurasthenic writer in the Syracuse Courier. It will be noted that the "thirdly" clause—that of cost—is passed over with the happy hint that the reasons why a municipal plant will cost more than one owned by a private corporation are "obvious." We respectfully commend the logic of the writer to our splenetic contemporary in "blew."

* * *

Electrical Journalism.

While the "oldest" and the "newest," the "best read" and the weekly-est electrical weeklies are filling columns—even pages of space lauding their own virtues and abusing their neighbors—all at the expense of their readers who have a right to expect wholesome reading matter for their money, THE ELECTRICAL JOURNAL goes along printing matter that will interest and be profitable to its readers. Our friends do our shouting.

* * *

Our *Blew* contemporary calls his lonesome wail against the City Electrician of Chicago "A Storm of Opposition." That's really funny.

Now that the British Government has pressing business on hand with Germany, we suppose the Venezuela affair will be turned over to Prof. Forbes "and his millionaires" for adjudication, and in the crash of empires that must follow we will recall the old couplet: "For want of a nail the shoe was lost, for want of a shoe the horse was lost," etc.

* * *

A board of judges in Germany has just decided that it takes 1,000 volts to kill a man, and blames two men for allowing themselves to be killed with 800 volts. Is this a special German standard? If so, England had better take measures to avert German resistance of this sort before proceeding to actual war.

* * *

A Kansas City paper tells of a boy who was injured by lightning and who had his teeth electroplated by the same charge. Here is a problem in electro-chemistry for some of our scientists. How did it happen? Or perhaps the problem is one that should lie between the reporter and some good insanity expert.

* * *

An exposition will be held in London next June under the honorary presidency of H. R. H. the Prince of Wales in which electricity will be an important factor.

* * *

CHICAGO TECHNICAL CLUB.

On November 14th, last, a number of gentlemen, members of the engineering profession and allied interests, discussed the advisability of forming a club modeled on the line of the Engineers' Club of New York City, the membership of which should include engineers, architects, railway officials and representatives of allied interests. It was proposed that the usual accommodations of a club-house should be provided, including a restaurant and sleeping apartments, all of which, it was thought would be maintained on a low basis of dues, especially if the non-resident membership should be large as was confidently expected would be the case.

A circular letter was prepared under the direction of a committee consisting of Chas. E. Billin, H. F. J. Porter, A. Sorge, Jr., and B. M. Gardner, and sent out to over 700 engineers and others, with the understanding that when 150 acceptances were had a meeting would be called preliminary to effecting an organization.

The necessary number of replies having been received, a meeting was called for Friday, January 24th, at which Captain R. W Hunt was made chairman, and Mr. H. M. Wilson, secretary. After hearing the report of the original committee, it was decided to organize, and with this view, Mr. Chas. E. Billin was made chairman of a committee on organization and rules, and the committee was authorized to take the preliminary steps for receiving a charter. A committee consisting of A. Sorge, Jr., chairman; H. F. J. Porter and J. F. Lewis was appointed to select quarters for the club, and both committees were instructed to report at a meeting to be held January 31st.

The charter members of the club will contribute $50 each, which will be their initiation fee and dues for the first year. For others the initiation fee will be $50 and the annual dues $30 for resident members, and $20 for non-resident members.

Several propositions have been already made to the committee on quarters, all of which are under consideration. These are from the Boyce Building, Monroe Restaurant Building and the Great Northern Hotel. This latter contemplates giving the club the entire 16th floor of the Hotel, and is looked upon most favorably for the reason that from the windows of this floor a magnificent view of the lake can be had, and sleeping accommodations can be had in the hotel adjacent to the club rooms at any time, and would have to be paid for only as used, and would in addition do away with a certain portion of the staff of servants which would otherwise have to be kept constantly employed. Moreover, the cuisine of the hotel would be at the service of the club thus obviating the necessity of a special kitchen.

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MULTIPOLAR ARMATURE TYPES.*

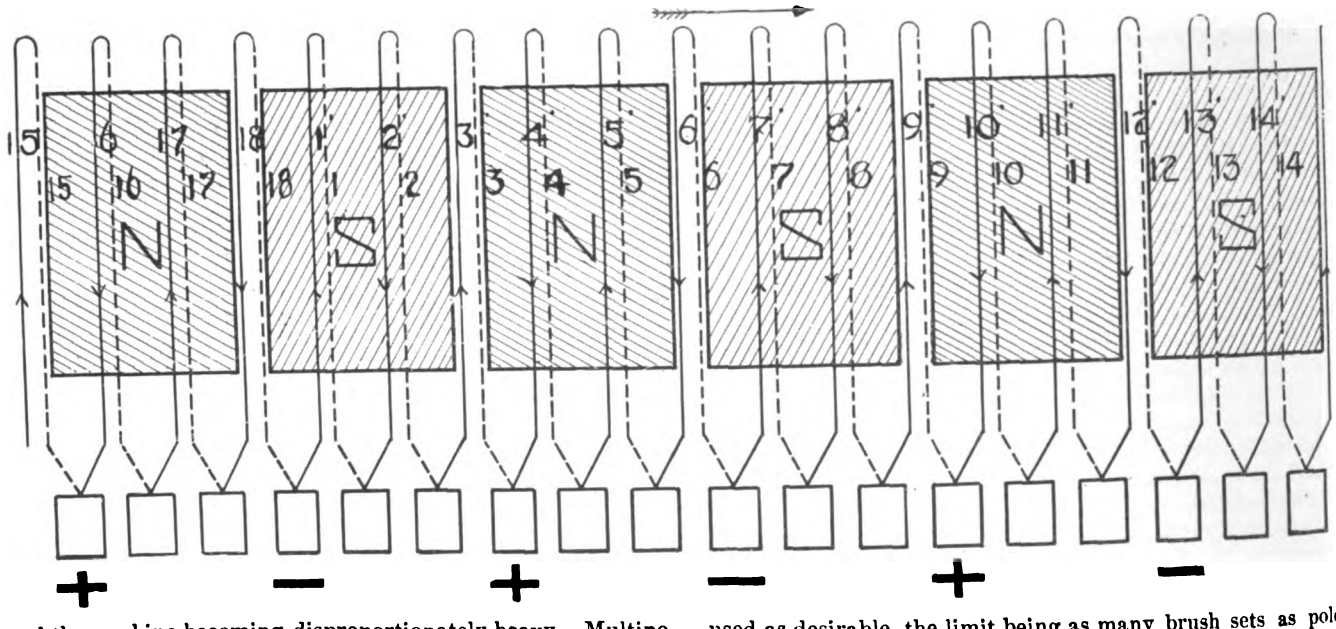
Detailed Description and Formulae for Making Gramme Ring, Parallel Loop Series and Gramme Ring Series Windings for Armatures of Multipolar Dynamos.

ILLUSTRATED BY DIAGRAMS AND DRAWINGS.

Only a few years ago the typical central station for lighting, power and railway purposes in this country was equipped with a large number of high-speed bipolar machines of moderate size run from the engines by means of belts and countershafts. As the demand for electric power of all descriptions and the size of central stations increased more and more a demand for larger units and lower speeds arose, the advantages of the employment of larger machines being a smaller cost of attendance, higher economy and smaller floor space, and lower speeds being desirable from a mechanical standpoint for a good many reasons. The advantages of connecting the dynamo directly to the engine became also more apparent every day. The bipolar type of machine is not desirable above a certain size, the difficulties with sparking increasing very rapidly with the output and the machine becoming disproportionately heavy. Multipolar machines were therefore adopted. The usual methods of winding bipolar machines were the gramme ring and the drum-winding invented by Hefner Alseneck, the disk winding being used only in a few instances. It was natural, therefore, when people commenced to build multipolar dynamos that they adopted the same styles of windings. The gramme ring winding of a multipolar dynamo is exactly like the one of a bipolar as can be seen on diagram 1. The winding corresponding to the drum winding of a bipolar machine is the so-called parallel loop winding which is shown in diagram 2. This winding is nothing more or less than a composition of three bipolar windings. We might cut the diagram into three parts and each part would be the diagram of a bipolar machine. The electrical conditions in both of these windings are, therefore, the same as in bipolar machines. The voltage generated is that generated under one pole, there are so many paths for the current through the armature and we need as many sets of brushes as there are poles. It is apparent that windings of this kind are very well suited for a machine with a large current and low voltage, but for a high voltage it requires a great many conductors on the armature making the construction expensive and the insulation difficult. There is the farther drawback in windings of this kind, that an inequality of the magnetic fields is accompanied with sparking at the brushes due to an unequal distribution of the current in the different circuits, although this last trouble can be overcome by proper design. The natural way out of this difficulty was, of course, that the conductors under the different poles be connected in series, and this was accomplished by what we call the series windings, also called one circuit windings.

The nature of a series winding may be shown in diagram 3, which shows a six pole series winding. Starting with coil 1 we do not connect with coils under the same poles, so that the current reaches 19 only after having flown through conductors under all poles. There are only two paths for the current through the armature and the voltage generated is that generated by half the number of conductors. In a six pole machine like this we only need one-third the number of conductors of that needed with either of the previous windings, the field strength and speed remaining the same. It can also be seen that an inequality of the field will have no influence on the armature current with this kind of a winding. There are only two neutral points on the commutator and therefore only two sets of brushes needed, but there can be as many more pairs used as desirable, the limit being as many brush sets as poles. Comparing figures 2 and 3 we notice the characteristic difference between the style of drum windings, the one forming a series of loops and therefore called a loop winding as remarked above, the series winding on the other hand having the appearance of waves, and therefore called a wave winding.

GRAMME RING WINDING.



In the further development of the dynamo cases arose, when a dynamo wound with a series winding would have too few conductors and if wound with a parallel loop winding would have too many, or a dynamo wound with a parallel loop winding would have too few conductors. For such cases the series or loop windings would be split up into several windings in parallel. Such a winding might consist of several independent circuits or it might be reentrant, reentrant meaning that if we start from one coil and follow the connections we return to the first coil after having run through all the coils on the armature.

It is therefore possible nowadays to wind an armature with any number of bifurcations, that may be desired, the number chosen in each case being depending upon the voltage between segments, ease of construction and general working conditions. If the number of bifurcations is large a parallel loop winding is more desirable because the brushes do not have to span so many

*Paper read before the Chicago Electrical Association, Jan. 17, by F. A. Muschenheim.

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segments as with the wave windings. There are also windings that are combinations of both classes, *i. e.* wave and loop windings. In that case one circuit would be controlled by a part of the poles only which is sometimes desirable.

Gramme rings may have series and series parallel windings In the same way as drum armatures.

The general formula for determining the number of conductors and the pitch to be used with a certain winding is as follows:

$$n=b\left(\frac{p}{2}y\pm a\right)=bs$$

In this "n" is the number of armature conductors, "s" the number of coils and "b" the number of conductors in one coil, a coil being the combination of conductors on the armature through which the current must pass after leaving a commutator segment to reach another. An armature generally has the same number of coils as there are commutator segments, but there might be less segments than coils. If a coil consists of several turns in the same winding spaces, the parallel wires are to be treated as one conductor. In a drum armature the coil generally consists of two conductors in different fields. In this case b=2 and the formula becomes $\frac{n}{2}=\frac{p}{2}y\pm a=s$. We give the two conductors of one coil the same number, distinguishing them by calling the conductors that form the beginnings of the coils 1^1, 2^1, 3^1, etc., and the ones that form the ends 1, 2, 3, as shown in the diagrams. In ring armatures a coil generally consists of one or more convolutions of wire in one winding space of the armature, as shown in diagram 1.

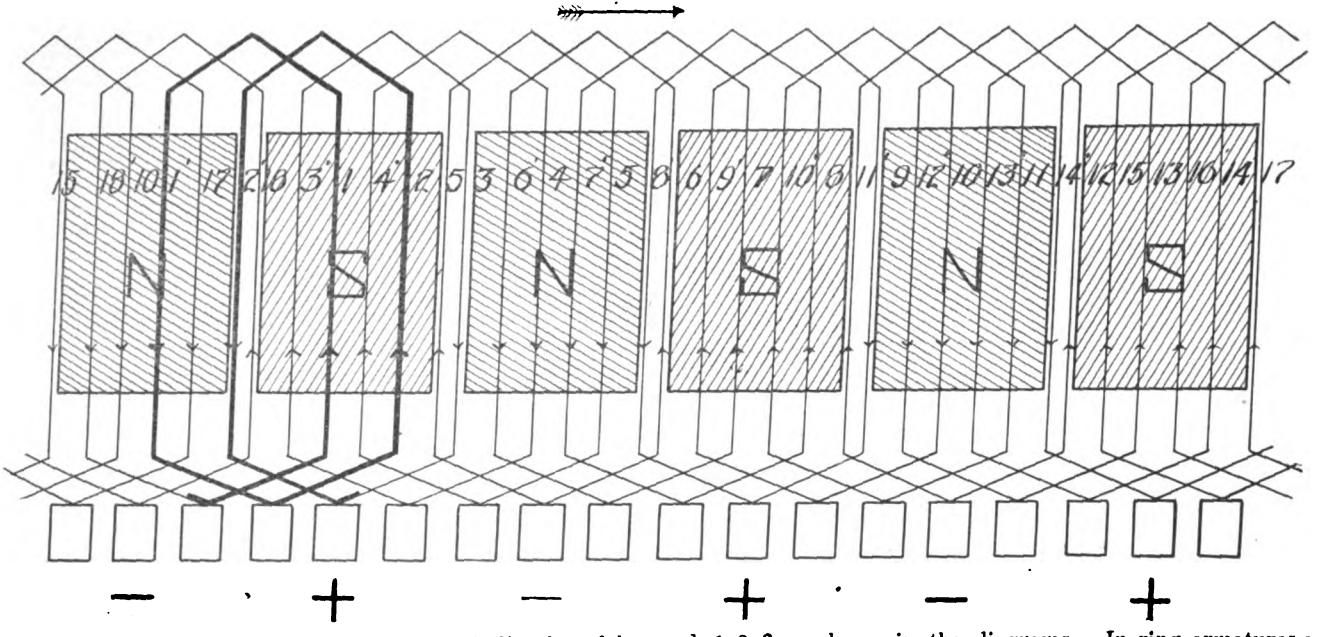
In this case b=1 and n=s.

The two ends of the coil are called a and a^1 respectively.

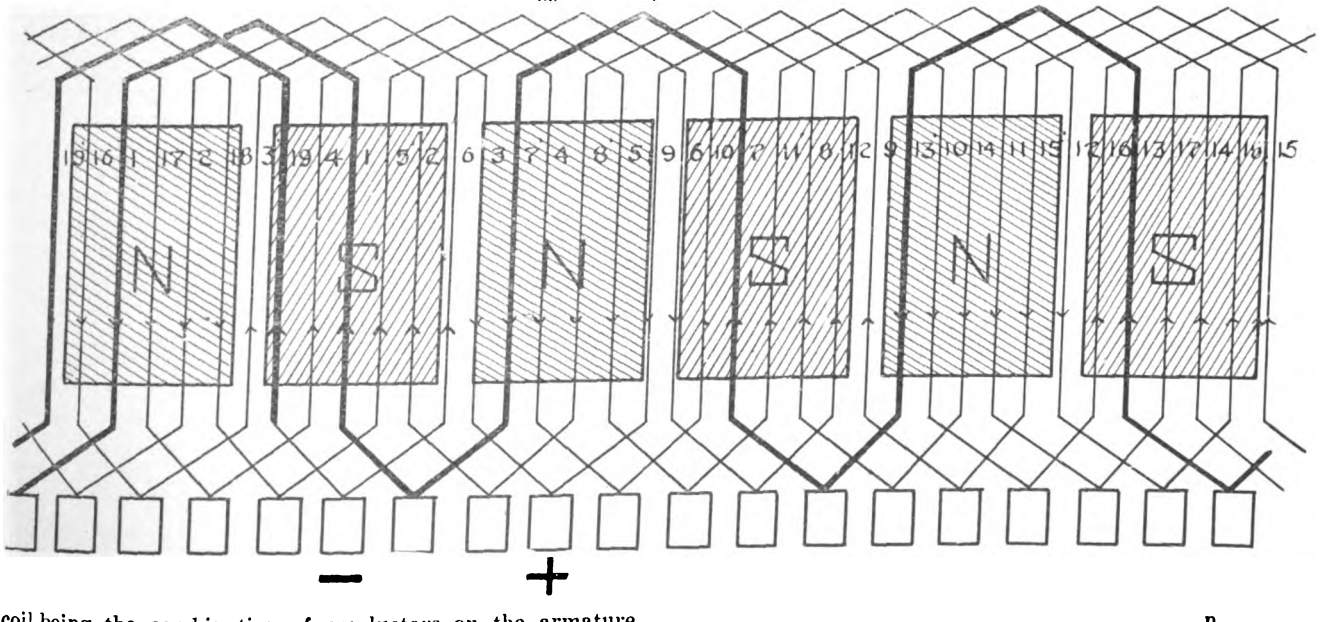
But a ring armature coil may also consist of two parts situated in different fields. In this case $b=2$ and $s=\frac{n}{2}$ as in the drum armature, the coils being numbered in the same way.

"p" signifies the number of poles and "y" the pitch or the number that tells us which coils ought to be connected together. If in a certain winding $y=5$ we join the end of the Xth coil

PARALLEL LOOP WINDING.



SERIES (WAVE) WINDING.



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with the beginning of the (X+5th) coil, etc.

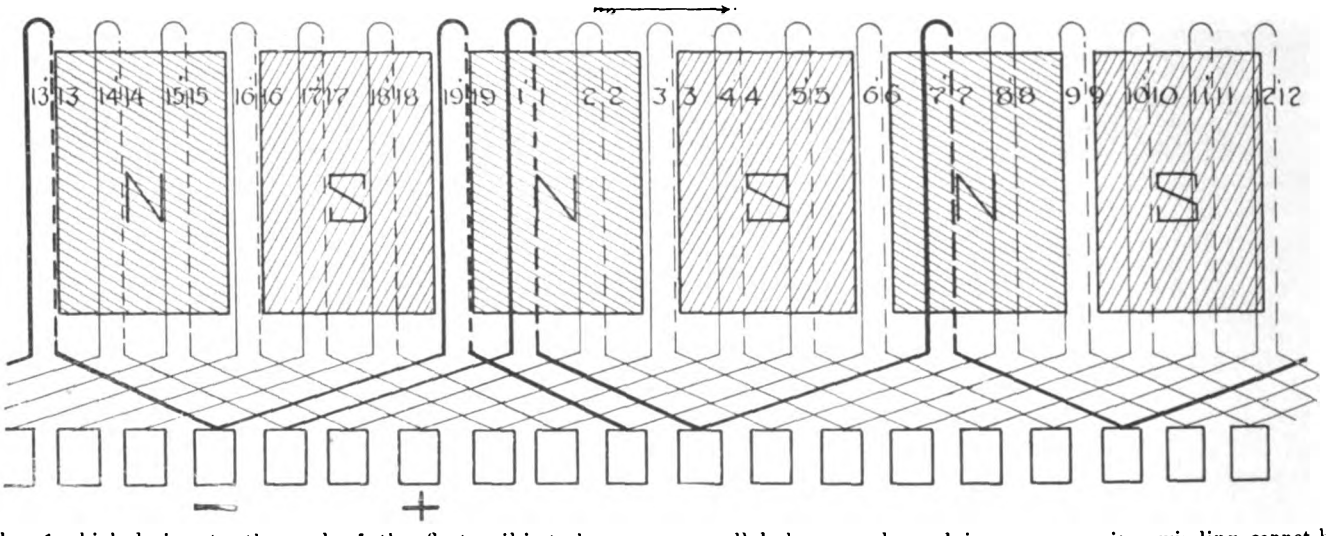
This number is found from the winding rule and in a ring winding like Figs. 1 and 4 will at once determine the whole winding.

The procedure with a drum or a ring winding having two parts of one coil under different poles is somewhat different. We start in with numbering one conductor of each coil, then we determine the pitch from the formula. Say the pitch is x.

This form shows plainly that the formula is nothing but a simple expression of the fact that we have as many paths through an armature as the algebraic differenceis between the number of conductors and the product p y. Or on the diagram, if we have completed one run under all the like poles the algebraic difference of the numbers of the coils we started and ended up with will give the number of bifurcations.

This is absolutely true only for the wave windings, because a

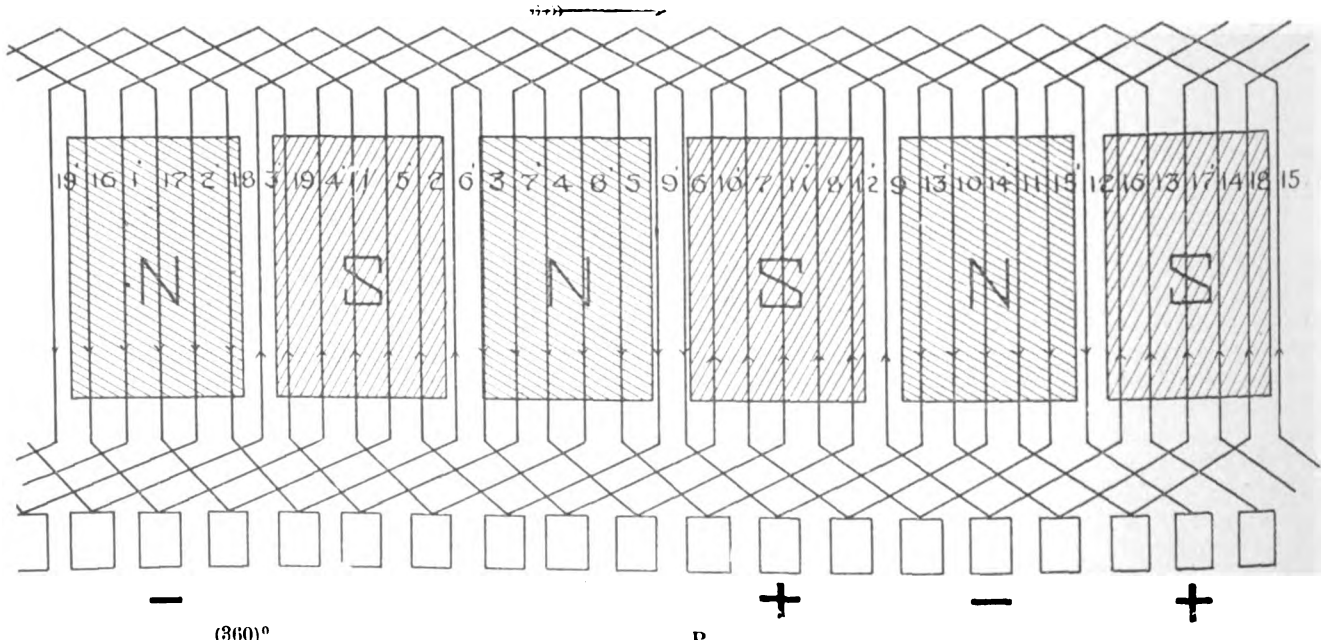
GRAMME RING SERIES (WAVE) WINDING.



Then 1 which designates the end of the first coil is to be connected with the beginning of the (1 + X)th coil. Now we know that consecutive coils occupy about the same position in the magnetic field. We therefore place this conductor $(1 + X)^1$ in about the same position relatively to the poles as coil 1. The polarity of the machine will depend on it just where we place it.

parallel loop and a plain gramme ring winding cannot be strictly considered multipolar, and this brings us to the application of the formula to the different windings. Let us consider the drum windings first. A parallel loop winding is, as I have mentioned, a bipolar winding, and therefore the formula of a bipolar machine applies to it, *i. e.* in the general formula

SERIES PARALLEL (WAVE) WINDING.



If we place it within $\frac{(360)^\circ}{P}$ the plus or positive brush will come under the south pole with right hand rotation and vice versa. Having fixed the position of this conductor we draw the rest of the connections parallel to the first.

Before showing the application of the formula to the different windings I want to say a few words about the formula itself. We might write it in this form:

$$p\,y = n \pm 2\,a$$

$\frac{P}{2} = 1$ and we have

$$s = y \pm a$$

which is the formula for the parallel loop windings; a in this case is the number of bifurcations under two poles or the number of armature paths under one pole. If it is one we have the plain parallel loop winding.

If we have a very low voltage and it is desirable to double the number of conductors, so as to decrease the current per bar.

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we put a=2 and solve for y. This will be a double parallel loop winding. We see that there are no limitations to the number of coils to be used, the formula giving a solution no matter what "s" is. But if a is larger than 1 the common divisor between y and s or between y and a will give the number of separate circuits on the armature. If they are prime numbers to each other we will have one continuous winding, or the winding will be reentrant. So in fig. 2. S=18, a=1 and y may be either 17 or 19. In this case we have chosen 17. We therefore connect 1 with 18^1 and place 18^1 so that it will occupy about the same position relatively to the poles as 1, then we connect the rest of the coils in the same way. Had we desired a double parallel winding a would have been equal to two and y would have been 16 to 20. 16 and 18 being both divisable by two and a being=2 we would have two separate circuits. It is not desirable in a practical armature winding that s be a multiple of p, because p number of coils will then be brought into short circuit at the same time.

In considering the wave windings we might begin with the plain series-winding. For this the formula becomes $s = \frac{p}{2} y \pm 1$ *i. e.* number of coils cannot be a multiple of the number of poles, or even half the number of poles, but there will be a difference of 1 between S and a multiple of $\frac{P}{2}$. If $\frac{P}{2}$ be equal $= 2$, *i. e.*, in the case of a four-pole machine S must always be an odd number. A winding of this kind is the most balanced winding we have because an inequality in the field cannot affect it at all and an inequality of the current in the two circuits will affect all brushes alike. It is furthermore the cheapest winding, requiring the least number of coils, the size of armature being also slightly diminished on account of the decreased amount of insulation. Only two sets of brushes are required with this winding, as with all wave windings, but any number can be used, the maximum, of course, being as many brushes as poles.

If the number of bifurcations is more than one we call the wave windings series-parallel or parallel windings, depending upon whether the number of bifurcations is smaller or equal to the number of poles.

We are limited in the number of coils we can use, by the formulas in the series windings. Furthermore, if y and s and a have a common divisor this common divisor will indicate the number of separate circuits in the armature. As we see, the number of bifurcations does not depend at all upon the number of poles. So we can have a six pole machine with two bifurcations or even with five, if we wanted to choose such a winding. Fig. 5 shows a winding of this kind.

The third kind of drum windings I spoke of as being a combination of a parallel loop and a wave winding, is derived from the formula by considering the machine being composed of several multipolar wave wound machines. For example, take an 8-pole machine and consider it as being composed of two 4-pole machines and apply the formula of such a machine, *i. e.*, $s = 2y \pm 1$, then we obtain a winding with 2 bifurcations, each bifurcation being controlled by 4 poles only. It is often possible in modern dynamos with detachable end connectors, to change the voltage of a winding by simply changing one set of end connectors. For instance, a series wound 220 volt four-pole armature can be changed into a 110 volt armature by changing one set of end connectors so as to make a parallel loop winding out of it, as we can see from the formula. The series formula is

$$s = 2y \pm 1$$

the parallel loop formula is

$$s = y \pm 1$$

The former necessitates that the number of coils is an odd number, the latter allows any number of coils.

A six-pole 220 volt series wound armature can be changed into a 110 volt series parallel armature by changing the connectors on one end. I shall show this by an example. Say the number of conductors = 19. In a 220 volt series winding the formula would be

$$s = 3y \pm 1$$

$$19 = 3 \times 6 + 1. \quad \text{Fig. 3.}$$

In the 110 volt series parallel winding the formula would be

$$s = 3y - 2$$

$$19 = 3 \times 7 - 2. \quad \text{Fig. 5.}$$

To apply the formula to a plain gramme ring wound in a continuous spiral seems hardly necessary. But to be complete I might say, as I have mentioned before, this winding is a bipolar one applied to a multipolar machine. We have to use the bipolar formula

$$s = y \pm 1$$

i. e., we connect a certain coil with the one to either side of it.

In series or a series parallel connected gramme ring, where the coils are complete in one winding space, the proper formula applies, *i. e.*,

$$s = \frac{p}{2} y \pm a$$

In connecting we find that we always jump one pole and connect coils under similar poles. Windings of this kind are used for arc lighting. They have the advantage that the voltage between adjacent coils is only small. Fig. 4 shows a winding of this kind.

In the gramme rings with winding spaces for one coil under 2 poles the voltage between adjacent coils is the full voltage of the machine. In regards to the winding formula they are treated in the same way as drum armatures.

ELECTRICITY ON RAILROADS.

President Caldwell of the Lake Shore Railroad is quoted as follows in the Cleveland Press:

"Practical application of electricity to motor power on railroads," said he, "is a grand possibility, but as present it is in its incipiency. Americans love to be whirled through space at lightning speed, and rapid transit is one of the questions of the day."

"What is essential to induce the railroads to operate their lines by electricity?"

"Economy of operation is the vital point and as soon as an electrical apparatus is devised that is cheaper than steam power, then will every road in the country adopt it. The Lake Shore will be one of the first roads to demonstrate the practicability of electrical transit. However, while progress is being made in electrical application, other important matters must not be lost sight of.

"Track, wheels and roadbed would have to be materially improved to stand the added strain and friction of the increased speed. Eastern roads have been giving this matter much thought and the N. Y., N. H. & H. has in operation an electric road eight miles long, which has been making phenomenal time."

WORLD'S FAIR AWARDS.

Information has come by telegraph from Washington that the government has completed some of the medals awarded to World's Fair Exhibitors, and that they will be distributed during February. We make the prediction now, however, that there will be as much dissatisfaction over their distribution as there has been over the delay. Large and very able bodied rumors have been floating about that politics is having a good deal to do with Mr. John Boyd Thatcher's little award snap, and that debts that cannot be paid in more convenient form are to be paid in World's Fair medals and diplomas.

Inability to make collections promptly forced the Standard Electric Co. to make an assignment on the 16th inst. Vice President and General Manager Perry in an unofficial statement said that the assets of the company were largely in excess of the liabilities, and arrangements are now being made whereby the company will shortly resume.

The subscription price to the ELECTRICAL JOURNAL is $2.

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THE MILWAUKEE CONVENTION.

The Northwestern Electrical Association Met on January 15-17, 1896.

DETAILS OF THE BUSINESS PROCEEDINGS.

The semi-annual meeting of the Northwestern Electaical Association was held in Milwaukee January 15-17, and as usual was marked by a goodly attendance of experts, central station men and representatives of supply houses.

President Grimm opened the proceedings and delivered his annual address in which he complained that the business end of the association was not in as good condition as should have been expected and suggesting a radical reform in the matter of dues and assessments. He also advised that a larger interest be taken in the matter of construction regulations and rules and pointed out a remedy for these evils.

The forenoon was then devoted to the transaction of routine business. In the afternoon Wm. J. Buckley, author of "Electric Lighting Plants, Their Cost and Operation," read a paper on "Modern Apparatus vs. Existing Conditions."

On the morning of the second day, Thursday, Mr Leland L. Summers gave a blackboard talk on "Central Station Economics" and, in the absence of Mr. Arthur Vaughn Abbott, C. E., who was to have read a paper on the "Economic Expression for Fuel Values," Mr. Summers gave a talk on the combined subjects. Mr. Fred DeLand then read a paper on the "Upbuilding of the Small Town." In the afternoon the following papers were presented: "Storage Batteries in Central Stations," by Maurice Barnett; "Some Facts About Acetyline Gas," by John C. McMynn, M. E., and "The Arnold Electric Power Station System," by E. R. Cunningham.

Papers on "Economical Results in Modern Isolated Arc Lighting," by F. E. Drake, and "Water Purification by Steam," by John McN. Wilson were presented on Friday.

The following are the officers elected for the ensuing year: President, W. B. Baker, Waupaca Wis.: First Vice President, Charles D. Wyman, Milwaukee; Second Vice President, H. C. Higgins, Marinette, Wis.; Secretary, Thomas R. Mercein, Milwaukee; Treasurer, John Schuelte, Manitowoc.

The next semi-annual meeting was fixed for the middle of July, and it was decided to hold same in Marinette.

The hours fixed for meetings were fully taken up with the business on hand, although there was no lack of Milwaukee's usual hospitality shown after business hours. No attempt was made to make a special exhibit by the supply houses, which fact was the subject of much regret to the members of the Association.

The banquet, under charge of a committee consisting of H. Andrae, O. M. Rau, and W. C. Smith, was given in the hall of the Pfister Hotel on Thursday evening and was an unusually brilliant affair replete with witty sayings and repartee.

Among those present were: F. N. Boyer, M. C. Wheaton, A. C. Bunce, W. S. Howells, and R. A. Swain, of the General Electric Co.; George Cutler, of Chicago; C. O. Baker, of the Chicago General Fixture Co.; F. S. and A. S. Terry, representing the Sunbeam Incandescent Lamp Co.; M. B. Austin, of the Safety Insulated Wire and Cable Co.; B. I. Arnold, of Fort Dodge; Thomas G. Grier, of the Bryant Electric Co.; Joseph M. Hill, of the Columbia Incandescent Lamp Co.; W. I. Buckley, J. C. Murphy, and C. E. Wilson, of the Fort Wayne Electric Co.; H. H. Brooks and A. D. Chandler, representing the American Circular Loom Co.; H. I. Gille, of Washburn & Moen Manufacturing Co.; F. S. Viele, of the Standard Underground Cable Co.; H. D. Latimer, of the Central Electric Co.; George S. Searing, representing the Hart Switch; James Wolff, of the New York Insulated Wire Co.; C. W. Woodward, of the Electric Storage Battery Co.; W. W. Low and William Wilson, of the Electrical Appliance Co.; Ernest L. Clark, Lewis H. Rogers, of the Adams-Bagnall Electric Co., and G. G. Dudley, of the Royal Electric Co., of Peoria.

POLLAK'S RECTIFIER.

A Novel Apparatus for Changing Alternating into Pulsating Currents. An Efficiency of 96 Per Cent Obtained.

Mr. C. Pollak, of Frankfort, Germany, has devised a new and ingenious apparatus for the conversion of alternating into pulsating currents, and which, from the description and cuts as furnished by advance sheets of the consular reports of the State Department at Washington for January, seems remarkably well adapted for the purpose.

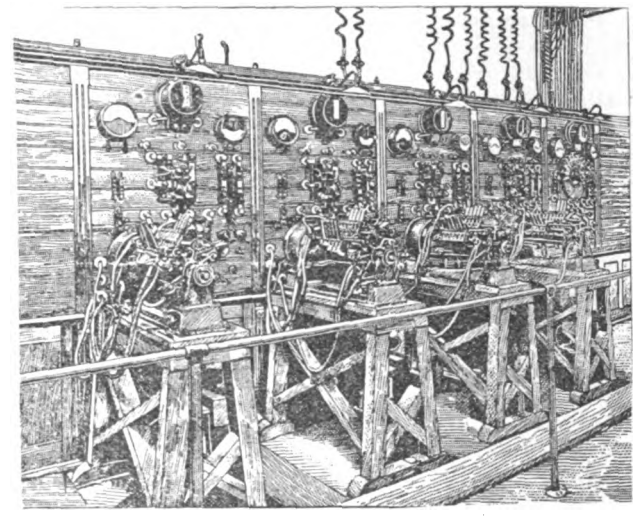
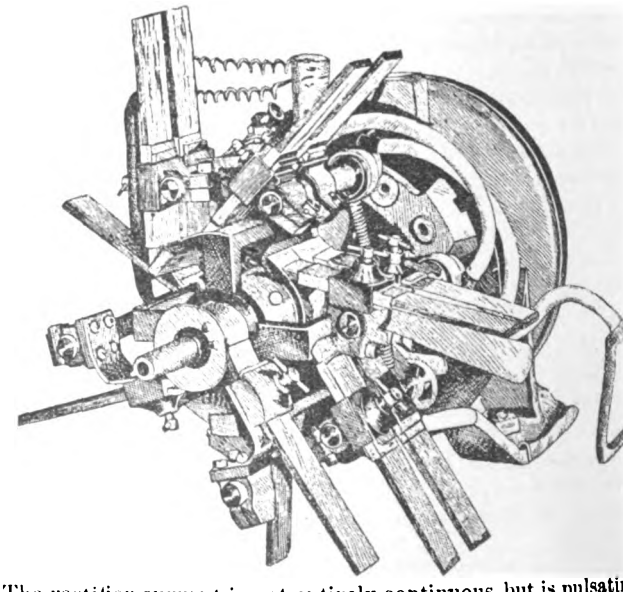


Figure 1 shows the rectifier station which is supplied with alternating currents at a voltage of 3,000 from the Frankfort Central station, and which is then transformed to a voltage of 65 before being rectified. The rectifier consists essentially of two rings—through which the alternating current is received and a commutator, mounted on the shaft of a small synchronous motor which gets its current through a special independent small transformer. As the motor is small, it requires but very little power, and on starting can be brought to synchronism by hand very readily, after which it needs no further attention.



The rectifier current is not entirely continuous but is pulsating, the length of the pulsations being governed by the width of the commutator bars and by the speed of the generator at the Central station, and is taken from the commutator through the four sets of brushes as shown in Fig. 2, the brushes being connected alternately in pairs.

The outer circuit of this pulsating current contains an ammeter, a fluid resistance, automatic disconnector, and in

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parallel shunts, voltmeters, motors, lights, arc and incandescent and storage cells, the charging of which is a large item of the work done by the Frankfort Central station. The station shown in Fig. 1 is very compact and contains four rectifiers of 350 amperes capacity each, and has been in continuous service for over a year with complete success. Their efficiency is stated to be 96 per cent the loss including a slight re-action of 2 per cent on the transformer.

Mr. Frank H. Mason, United States counsul at Frankfort, Germany, is the author of the report which is much clearer and succint than are the majority of such papers on technical subjects.

BOOK REVIEWS.

SCHOOL PHYSICS--A Text Book for High Schools and Academies. By Elroy M Avery, Ph. D., L. L. D., author of a series of physical science text books: Sheldon and Company, New York and Chicago.

This is a text book of physics which has an apparent advantage over most volumes of this class, in that it departs from the beaten track of presenting certain facts for the pupil to accept ex cathedra and memorize to immediately forget. It contemplates a practical laboratory course to be taken in connection with the text, but the experiments prescribed are intended to be performed by the pupil and only after the lesson has been thoroughly mastered and the pupil fully understands the results that must be attained. An attractive feature of the course of preliminary experiments, that are intended to fully ground the pupil in the fundamental theories of science, is that the apparatus needed is improvised from the common objects usually found in any school room, such as chalk boxes, pointers, etc. Numerous practical problems are also presented for the pupil to work out and these are so arranged that any one can be easily worked out with the knowledge gained in working out the preceding ones.

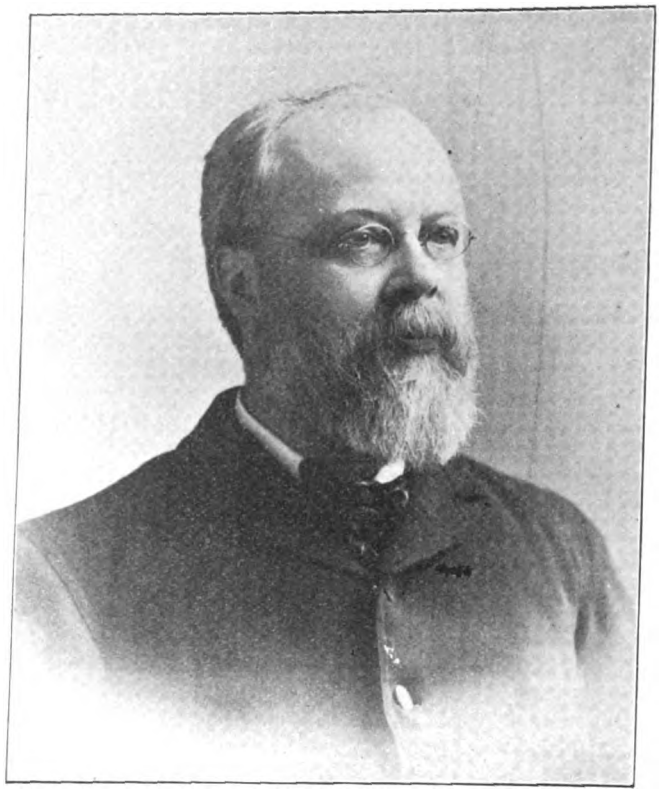
APPLETON'S SCHOOL PHYSICS.—Embracing the results of the most recent researches in the several departments of Natural Philosophy, by John D. Quackenbos, A. M. M. D., (literary editor.) Alfred M. Mayer, Ph. D., Professor of Physics, Stevens Institute of Technology, Hoboken, N. J.; Francis E. Nipher, A. M., Professor of Physics, Washington University, St. Louis; Silas W. Holman, S. B., Associate Professor of Physics, Massachusetts Institute of Technology, Boston; Francis B. Crocker, E. M., Professor of Electrical engineering, School of Mines, Columbia College, New York: American Book Company, New York, Cincinnati, Chicago.

The list of distinguished authors enumerated above is a sufficient guarantee for this volume. A careful perusal of the book only confirms this estimate of its character. The various subjects are presented in their logical order and in a careful, clear manner. While algebraic formulas are used to some extent in certain portions of the work, in no instance are they of such character that they cannot be explained in arithmetical terms by any teacher of ordinary ability. The chapter on magnetism and electricity are particularly interesting and of such character as to be easily understood by the average pupil.

ACETYLENE GAS.

In reply to several inquiries we beg to say that calcium carbide is advertised for sale by at least the following manufacturers of the article, none of whom pay any royalty to Willson or the Electro Gas Company, or apparently recognize their patents. The Electrocthemische Werke at Bitterfeld, Prussia. Sales office, 29 Louisen Strasse, Berlin. Aluminum Industrie Actien Gesellschaft, Neuhausen, Switzerland; and also at the Manheim Works, Baden.

Whatever may be the candle power of acetylene gas, it certainly is a bad illuminant on the question of its own cost, or the profit in its manufacture, for not one of all its votaries has yet been able to make any statement capable of analysis which would show that its actual cost would render it a serious competitor of our present poor gas, or that the "rights" of the Electro Gas Company will enable that concern to earn more than a modest competitive manufacturers' profit on the business of making and distributing it.—*Engineering and Mining Journal.*



RALPH WAINWRIGHT POPE.

It is quite unnecessary to introduce to the electrical public, the subject of this sketch, Mr. Ralph W. Pope, permanent secretary of the American Institute of Electrical Engineers.

Mr. Pope was born at Great Barrington, Mass., on August 16th, 1844. He received a good common school education in Great Barrington and at Amherst, Mass, and in 1858 had mastered the operation of the Hughes printing telegraph. In 1859 he entered the employ of the Housatonic railroad, and in 1861 was appointed operator in charge of the Morse telegraph office at Great Barrington. He was, in 1862 and 1863, in the service of the American Telegraph Co, in their New York, New Haven and Providence offices, and, in 1865, went to British Columbia with an exploring expedition for the Collins Overland Telegraph. He was appointed quartermaster at Quesnelle where he remained until 1865, when he returned to the east and was appointed agent for the Housatonic railroad at Pittsfield, Mass. In 1867 he went into the employ of the Bankers' and Brokers' Telegraph Co., where he remained until 1872, when he became inspector for the Gold and Stock Telegraph Co. He was promoted to the position of deputy superintendent in 1880, and in 1882 became the business manager of the Union Electric Manufacturing Co. of New York. In 1884 he was associate editor of the Electrician and Electrical Engineer. In 1885 he was elected Secretary of the American Institute of Electrical Engineers, and in 1890 he founded Electric Power. In 1891 he became editor for electrical terms in the Standard Dictionary, and in 1893 he had charge of the rooms of the American Institute of Electrical Engineers in Electricity Building at the World's Columbian Exposition where he enlarged his already large circle of electrical friends. He was appointed on the committee of Judges for the Department of Electricity, and since that time has devoted himself almost entirely to the affairs of the American Institute with occassional literary work.

As secretary of the Institute he is personally known to almost every electrical expert in the country, and as an expert himself has a very wide reputation.

As all the electrical people have come to know, Mr. Pope is a pleasant, affable gentlemen, sound and straightforward in all his dealings; of rugged honesty and of unfailing loyalty to his friends.

AN ARTISTIC CATALOGUE.

The Adams-Bagnall Electric Company, of Cleveland, Ohio, has issued what is probably the most artistic piece of work in point of illustration and typography that could have been presented as a catalogue. It describes their "A-B" arc lamp and incidentally gives a very concise history of the arc light and is illustrated with portraits of Davy and Farraday and numerous diagrams illustrating their discoveries. Of course the "A-B" arc lamp is not forgotten and its merits are ably presented. The catalogue is printed on the finest enamel paper with half-tone illustrations.

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ELECTRO-THERAPEUTIC DEPARTMENT.

STATIC MACHINE IN MEDICINE.*

Physiological and Therapeutic Action of Static Electricity—Effects of the Direct, Indirect and Induced Charge.

DETAILS OF THERAPEUTIC APPLICATION.

We have in Lesson XIV considered the structure and action of static machines for therapeutic work and the physical properties of the electric energy which they produce. It remains for us to study the behavior of the human organism in health and disease when subjected to electric conditions such as the static machine and its accessories can furnish.

The extremely high electromotive force of that electricity which is generated by the static machine renders it prone to break down the dielectric which surrounds all conductors and other bodies charged with it and so escape. The dielectrics or insulators that are employed in the operation of the static electric machines which physicians use, or the glass plates of the machine itself; the glass of the Leyden jars or condensers; the glass or hard rubber used for the various supports of the conducting parts of the machine as well as for the feet of the insulating stool, and lastly, the air which surrounds all parts of the machine and the objects in continuity with its conductors. In order that a body may be subjected to a high degree of static charge these various dielectrics must be capable of sustaining considerable strain without giving out, that is, there must be a sufficiently thick layer of air or glass or hard rubber separating from surrounding objects the bodies and conductors which the machine has brought to a positive potential so as to prevent the charge from escaping to the earth through some object which is in connection with it, and may serve as a conductor. Particles of moisture or dust in the atmosphere which surrounds the machine, aid in dissipating the charge which the machine creates, and for this reason a dry atmosphere and one free from dust is an essential if a static machine is to do its most successful work.

The physical conditions created by means of the static machines that have been employed in therapeutics may be enumerated as follows:

Static insulation,
The direct spark,
The indirect spark,
The friction spark,
The spray or breeze,
The needle spray,
The static induced current.

Static Insulation or Charge.—In this form of administration the patient sits upon the insulated stool or platform, which is attached to one or other, usually the positive, pole of the machine by means of a conducting chain or rod. When the machine is put in motion the body of the patient, thus forming the terminal of the conductor, is raised to the potential the machine is capable of producing, and the patient becomes the storehouse of a positive or negative charge, depending in amount upon his or her electrical capacity. Just here there is need of some careful study in the comparative effects of positive and negative insulation. It is very generally agreed among those who have employed this form of treatment that it is followed by marked nutritional effects, yet some claim that positive insulation is stimulating and beneficial, and negative insulation is depressing and hurtful, while others assert that there is no such noticeable difference in effects between them, but that either form of insulation will prove tonic and invigorating. Only a carefully arranged series of tests faithfully carried out in both the domain of physiology and therapeutics can satisfactorily settle this mooted question. It is claimed for static insulation, and as commonly employed this means positive insulation, that it will elevate a subnormal temperature, or lower a temperature abnormally high; that it will regulate and increase the volume of the pulse; that it will decrease the number but increase the depth of respirations; that to a person nervously excited and sensitive, it imparts a sedative effect and a sense of well being. The action appears to be to improve nutrition and regulate disordered function, although the manner in which a static insulation or bath operates to produce this effect has not yet been explained.

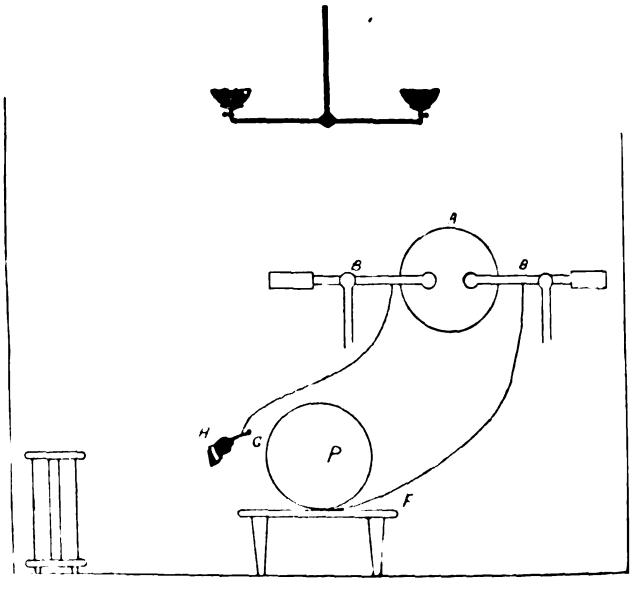

FIG. 71.—DIRECT SPARK—*Machine not Grounded.*

The Direct Spark (*Fig. 71*).—In giving the direct spark, the patient is placed upon the insulating platform F, which is connected by the chain or rod to either the positive B or negative (B^1) of the machine, and the first effect upon the patient P is to produce a static charge of either positive or negative potential, as the case may be. Here again the positive charge for the patient is ordinarily used and preferred. An electrode H terminating in a metal or gilded ball about two inches in diameter is attached to the other terminal of the machine B^1. When this electrode is made to approach the body of the patient at any point, the layer of air which surrounds the patient and acts as a dielectric is thereby rendered thinner G, and less capable of sustaining the strain to which it is subjected, and finally it is so thinned by the nearer approach of the ball electrode that it gives way and the static charge in the patient's body suddenly becomes transformed to current electricity and escapes, leaping the air space in its transit and causing a spark.

The physical phenomena here are the sudden dissipation of a static charge which had been maintained in the charged body at a very high potential. The discharge is often if not always oscillatory in character, the oscillations numbering many thousands per second. The current, by reason of the extremely high resistance to be overcome at several points in the circuit, is very small, usually but a fraction of a milliampere. The human organism, which is for us the point in the circuit of greatest interest, is suddenly subjected during a treatment of this nature to a high electric potential, which it as suddenly loses as often the ball electrode is brought sufficiently near to some part of the body to cause sparking. As all parts of a charged body are at a uniform potential, a change must take place throughout the entire organism when the potential is

* Lesson XV of the Therapeutic Course, National School of Electricity.

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reduced to zero, as is the case when a spark crosses the air gap, and if this discharge is not instantaneous in its decline of potential but oscillatory, with gradually decreasing amplitude of oscillations, the organism must be subjected to corresponding disturbances in its molecular arrangement throughout. The tissues of the human body are not uniform in conductive capacity, consequently the density of the charge is not uniform throughout the entire organism. Both during charge and discharge, therefore, the human body must be supposed to act quite differently from a mass of metal of equal size and form under similar electric conditions. Certain of the tissues conduct readily while others possess the characters of dielectrics. There would therefore, be innumerable spots of strain and slip in close relation which must be taken into account when we attempt to analyze the effects produced during a static treatment. But whatever may be the fact as to the spark discharge causing molecular excitation of the entire organism, a series of phenomena capable of ocular demonstration always occurs at that part of the body where the discharge takes place. There is a sudden blanching of the skin, due to vaso-motor constriction over a circular spot greater or less in diameter, according to the strength of the discharge; this is soon followed by a vaso-motor dilation and the spot is correspondingly reddened, a condition which remains for a considerable length of time after the treatment. The muscles underlying the point from which the discharge takes place are caused to contract and sensations of a variable nature, referred to the same spot, are prominent accompaniments. These sensations are an important element in the treatments, for upon their nature often depends the good or bad effect which the patient experiences. The direct spark from small machines is much more likely to be stinging, pricking and irritating than from large machines, and it is claimed that grounding the machine has the effect to render the spark much less disagreeable than when the circuit is confined to the machine, the conductors and the patient, as is the case when using the direct spark. The static spark is of great value in arousing to more active nutrition any organ of the body that is subjected to this treatment. The skin, the vascular tissues, muscles and nerves are stimulated by it. Its effects are more generally distributed throughout the body than is the case with the direct or induced current applications, so that it is well suited for correction of systemic disorders, such as rheumatism, gout, neurasthenia, spinal irritation, and general sluggishness in nutrition from whatever cause. Unmistakable evidence is given of its power to quicken nutritive processes by the way in which the perspiratory and sebaceous glands are set to work by it, and the improved bodily comfort that follows such applications is, due in a great measure, no doubt, to the more perfect elimination of effete matters from the body.

It is sometimes difficult to give the spark treatment to special localities of the body by means of the ordinary ball electrode for the reason that the current which causes the spark invariably seeks the line of least resistance. A directive electrode, such as the Morton electrode (*Fig. 73*), is of much service in getting exact local effects, and by means of it the spark can be drawn from accessible surfaces within the cavities of the body when it is thought desirable.

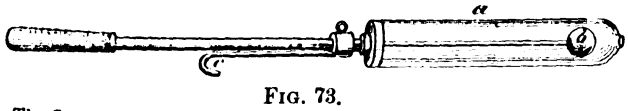

FIG. 73.

The Indirect Spark.—In order to get the indirect spark the machine must be "grounded." This is done by putting the negative prime conductor or pole of the machine in communication with the earth by means of a conductor running from it to a convenient gas-pipe or water-pipe. The electrode used for the purpose of drawing sparks should also be grounded. This has the effect of increasing the quantity of electricity which the machine generates and of improving the constancy of its action. The spark is likely to have more volume and is cleaner, with less irritating properties. It is more satisfactory, therefore, when using the spark treatment to have the machine grounded. A sputtering series of sparks is very disagreeable to most patients and irritates the sensory nerves and should always be avoided except when this effect is sought for, as is the case when counter-irritation or skin excitation is desired. It insures a clean, full, individual spark to have the machine well grounded and then make the ball electrode approach the part of the charged body suddenly to within the proper distance and as suddenly withdraw it.

The purpose and manner of the treatment with the indirect spark is the same as that with the direct spark, but the effect differs because of the physical and physiological differences which they possess.

The Friction Spark.—This is used mainly for excitation of the skin or the superficial blood vessels and is a convenient method for applying mild counter-irritation. The patient is insulated as with the spark treatment. A roller electrode (*Fig. 74*) is provided for this application but is not necessary since the large ball electrode will serve the same purpose. The only physical difference between this and the direct or indirect spark is that the dielectric is thinned down to a layer which is represented by the thickness of the patient's clothing. The roller or ball is passed over the spot treated directly in contact with the clothing, consequently the charge escapes at more frequent intervals and with smaller sparks but with a prickling, biting or stinging effect upon the sensory nerves of the skin which is decidedly exciting to their function, and the reflex effect upon the nutrition of the skin is marked.

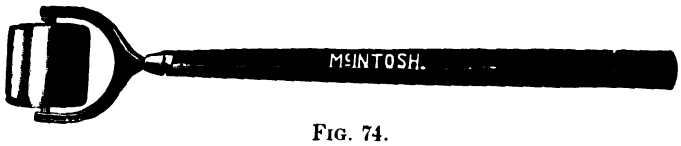

FIG. 74.

This form of treatment is of special service in correcting chronic malnutrition of the skin as in eczema and sensory paresis.

The Spray or Breeze.—Again the patient is insulated as before but the charge is withdrawn, not suddenly, as in the forms of treatment thus far mentioned; but slowly and in infinitesimal quantity by holding a pointed electrode (*Fig. 75*) at such distance from the part of the body to be treated that the discharge is not disruptive but is conveyed away by the particles of air forming the dielectric layer, each becoming charged with its load and seeking the opposite potential. This creates a current in the atmosphere surrounding the part of the patient's body under treatment. This motion together with the gentle, stimulating effect caused by the slight loss of potential in the surface which each instant takes place by the process of convection that is going on, constitutes the treatment.

The pointed electrode may be moved about over the patient's body. Or, by fixing it upon a stand, it can be so placed that the effect may be maintained for any desired length of time upon a particular part. A circle of points fixed at a suitable distance above the patient (*Fig. 76*), serves to distribute the "spray" or "breeze" uniformly over the head.

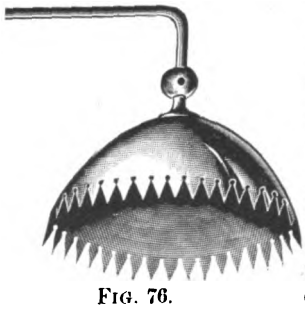

FIG. 76.

The static spray or breeze is peculiarly soothing and resting in its effects. By means of it a condition of nervous excitement and restlessness can be almost immediately allayed. Severe headaches of a nervous type are often quickly relieved and insomnia is frequently overcome.

The Needle Spray.—When only a part of the patient's body is brought in the direct line of charge, and so is raised to a higher potential, as would be the case if the conducting chain is held in the patient's hand instead of being placed on the insulating stool, and the pointed electrode is then brought near

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enough to the part to be treated to allow of minute disruptive drops of potential instead of the discharge by convection, the effect upon the part under treatment is much as if was being pricked by innumerable fine needles. This is decidedly stimulating, though at the same time irritating, and is in all respects of the same nature and used for the same purpose as the friction spark above described.

The Static Induced Current.—We are indebted to Dr. W. J. Morton, of New York, for bringing to our attention this very valuable addition to the therapeutic resources furnished by the static machine.

The static induced current is that current which results from a return to zero of the difference of potential that is created between the outer coatings of the Leyden jars or condensers

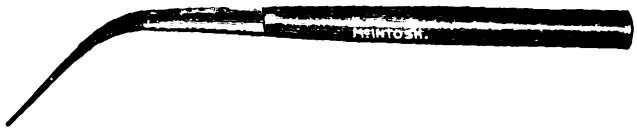

FIG. 75.

attached to the prime conductors of the machine (*Fig. 77*). At each instant that a discharge takes place between the prime conductors, the potential difference which existed in the interior of the Leyden jars is equalized, and a corresponding discharge takes place between the exterior surface of these jars, and this latter current can be utilized for therapeutic applications without the disagreeable accompaniment of sparks. The electrode for applying this current can also be placed in contact with the body and the various tissues and organs be be brought under its influence with more precision than is possible in the use of the spark or spray. All modern static machines designed for therapeutic work are furnished with connections that permit the use of the static induced current. For the regulation of this current it is only necessary to regulate the discharge between the prime conductors of the machine. A small spark-gap permitting frequent minute discharges will be attended by a similar frequency and feebleness in the static induced impulses. A wider separation of the prime conductors will result in heavier discharges at longer intervals. The strength and frequency of the impulses of the static induced current is thus readily controlled. The nature of this induced current is similar in potential to that of the inducing current. The milliamperage depends upon the resistance offered in the circuit. It is in all probability, at times at least, oscillatory in character, although this remains to be determined with certainty. As to the physiological effects and the therapeutic applications of the static induced current we will quote the words of

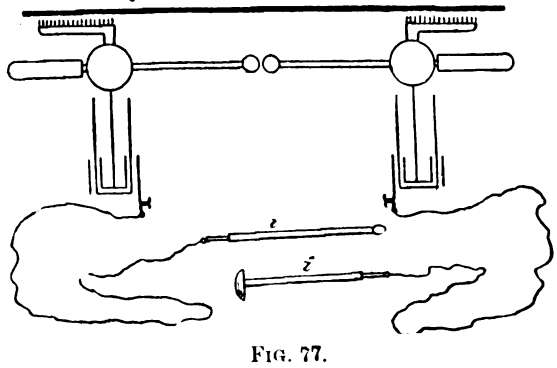

FIG. 77.

Dr. Morton himself, whose rich experience in the use of this current will give to his conclusions the weight of authority;

"Applied to a motor point, the static induced current produces most vivid and persistent muscular contraction with a minimum of pain; applied further back on the trunk of a motor nerve it throws large groups of muscles into contraction. The contraction is peculiarly painless as compared with that of faradic coils, and the influence is remarkably diffusive. Accompanying a contraction of a large group of muscles is a peculiar sensation of lightness and buoyancy of the member. The painlessness, diffusiveness and buoyancy may all be experienced by holding the two electrodes in the hands, and taking a current as strong as possible. Most people will readily submit to flexions successively at the wrists, elbow, and even to the shoulders before insisting upon taking no more. The arms during the passage of the current feel as if made of cork, and this feeling of lightness persists for some time. It is the same feeling, doutless, though here exaggerated, as is commonly referred to as the refreshing effect of general electrization. The quality of the current is such, that while energetically exciting the motor function of the nerve filaments, it fails to excite or may even annul, to an extent, the sensation of muscular pain. Its penetrating, diffusive, painless effect, with strong muscular contractions, adapt it admirably to general application over the entire body as an electric in place of an ordinary massage.

"It is, of course, applicable to every form of muscular paralysis, for there is no practical stimulus to nerve and muscle except the electric, and none more energetic than this form of it.

"Its effects upon the Hallerian irritability of the muscular tissue necessarily includes an effect upon the local circulation of a part and upon the lymphatics, and to this may doubtless be referred many clinical results of relief, as in lumbago and all forms of muscular rheumatism, subacute and chronic rheumatic affections of the joints, ovarian or pelvic pain, sciatica or other neuralgias.

"The second prominent characteristic of this current is its power of relieving pain. Leaving out of sight the part, be it more or less, played by circulatory changes referred to, in this respect there seems to exist a specific analgesic quality in the current. The cotton feeling in the hands and subjective sense of buoyancy in the arms is in itself an evidence of this. But the effect upon pelvic pain, upon ovaritis, upon neuralgias, pleuritic 'stitches,' tonsillitis and many other pain affections is still better evidence. In sciatica, for instance, the sensation of pain is frequently quickly relieved and a cure obtained, though I think in this case the cause is twofold—that is to say, due to both the circulatory and the analgesic effect. The same I believe to be true in the pelvic and ovarian pains.

"The results in such cases, in my opinion, are far superior to anything obtainable by a faradic or a galvanic application. An ordinary faradic current will increase the pain, the galvanic will very often relieve it. But we have in the static induced current no comparison to the electrotonic and polar effects, or in general the electrolytic effects of the direct or galvanic current. Therefore, when the static induced current has failed to act favorably, we should try the galvanic, and *vice versa*. As no observations on the purely analgesic effects of this current have hitherto been made, I must leave others to test the question for themselves."

It will be seen from this brief review of the methods of practical application of the effects obtained by means of the static machine, that it is capable of doing a variety of work in therapeutics which no other form of electrical apparatus can accomplish; but the good results obtainable can only follow when the action of the machine is fully understood by the operator and the case to be treated is one adapted to the form of treatment employed.

GALVANIC CURRENT IN DYSPEPSIA.

The European journals are telling of some ingenious work in electro-therapeutics being done by Einhorn and Ewald, direct currents of from 15 to 25 milliamperes are used on the stomach for indigestion. One electrode is placed at the pit of the stomach and the other in the stomach itself, which has been previously half filled with water. This treatment is suggested for dyspepsia and other disorders due to faulty nutrition.

The subscription price to THE ELECTRICAL JOURNAL is $2.

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MORITZ HERMAN VON JACOBI.

Born at Potsdam, Sept. 21, 1801. Died March 10, 1874. Discovered that the Earth could be Used as Return Circuit. Invented Electrotyping. First to Apply Electricity to Warfare; Organized a Corps of Electricians for the Russian Army.

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The Electrical Journal.

Vol. 1. CHICAGO, FEBRUARY 15, 1896. No. 18

THE SCIENCE OF PHOTOMETRY.

Definition of the Term "Efficiency" As Applied to Incandescent Lamps—Economical Service of Lamps of Present Make.

LONGEST LIFE NOT ALWAYS MOST EFFICIENT.

A useful addition to the apparatus named in the previous article, is a holder for the incandescent lamp, so arranged that the lamp may be turned into any desired position, its center remaining at a fixed distance from the photometer disc. Such holders usually have two axes, perpendicular to each other, each provided with a divided circle, or a notched disc, so that definite angular settings may be made as called for in the scheme of measurement to be followed.

Figure 1 shows the form of holder used in the Franklin Institute tests of 1881.

The amount of light given off by a lamp in any direction depends upon the temperature of the filament, upon the area of filament surface turned in the given direction and also to some extent on the shape of the lamp bulb. If the section of the filament be rectangular, the strongest light will be found in a direction perpendicular to the broader filament surface. If the filament be round the light given off will be practically the same in all horizontal directions. In studying the horizontal distribution, it is usual to measure the candle power of the vertical lamp in the "standard position," with the plane the lower ends of the filament perpendicular to the length of the photometer bar, then turn the lamp 30° about the vertical axis, read the candle power again, and so on until the lamp has been turned to the first position. The mean of the first and the thirteenth readings being added to the other eleven readings, and the sum divided by twelve gives the "mean horizontal candle power." This does not give the exact value, for in some directions a considerable strengthening of the light is caused by reflection from the globe. One may easily observe this by holding a lamp near a white surface and turning the lamp around, when quite bright streaks of light will be observed in certain directions. To obtain the true average candle power would require a very large number of readings in directions differing but little, but the labor involved is too great. When one wishes to obtain the "mean spherical candle power," or average candle power in all possible directions, it is necessary to make use of both horizontal and vertical axis of the lamp holder. The plan is too complicated for our purpose. An account of one such scheme of measurements, together with an excellent series of figures showing the results obtained on several makes of lamps, may be found in the report of the committee on lamp tests, of the Philadelphia Electrical Exhibition, 1884.

A discussion of the many interesting facts concerning the performance of incandescent lamps, which have been discovered with the aid of photometric and electrical measurements, would carry us beyond the purpose of these articles. Mere eye inspection shows that the candle power of a lamp increases rapidly with the strength of the current passed through it or with the voltage applied to it. Measurements show that the candle power, at the usual degree of incandescence, varies approximately as the cube of the watts expended in the lamp. Life tests of lamps show that the candle power changes with time; in some lamps beginning to diminish from the start, and in others increasing at first and decreasing later. With lamps of a given make and rating the decrease in candle power is more rapid as the degree of incandescence maintained is higher. Moreover the length of time that the lamp will burn before its filament breaks is much shortened by such use. One authority states that the time is decreased one-half by running the lamp at a voltage three per cent. high.

As lamps cost something, it was long the common opinion that the best lamp was the one which could be made to give light for the greatest number of hours. During that period, less than four years ago, lamp makers quoted records of lamps of their

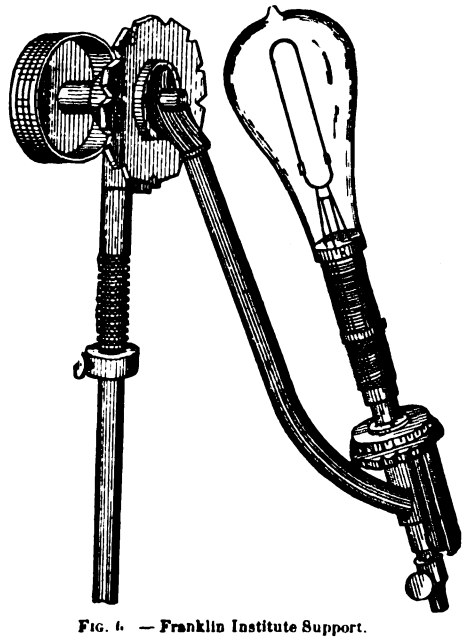

FIG. 1. — Franklin Institute Support.

makes, which had burned continuously for from 3,000 to 10,000 hours. It is now recognized that that lamp is best which will, while maintaining a sufficiently strong and white light, produce the greatest total amount of light (expressed in candle power hours) at the least cost for lamp and power. In order to illustrate our meaning, the results obtained in a certain test are graphically shown in Fig. 2. Curve 1 is the "economy curve" of the lamps tested. They were nominally 16 candle power lamps, and developed when new an average of 13 candle power, at an expenditure of 4.4 watts per candle power. After the initial measurements, the lamps were put on circuit and run for over 800 hours. At suitable intervals their candle power and efficiency were measured. From the data so obtained the total number of candle power hours afforded by them from the start up to 100 hours, then from the start up to 200 hours and so on, was found by multiplying the average candle power through the given interval by the number of hours in the interval and by the num-

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ber of lamps. Similarly the amount of electrical energy, in watt hours, expended in the lamps during corresponding intervals was found by multiplying together the average number of watts per lamp, the number of lamps, and the number of hours. Multiplying the total watt hours by the cost of one watt hour, we get the cost of the energy used. Adding to this the cost of the lamps we have the total cost of the light produced. By dividing the cost by the total number of candle power hours, we have the *average* cost of one candle power of light for one hour, from the start to the given time. To illustrate, suppose five lamps were used for 100 hours and gave an average of 16 candle power each during the 100 hours, the lamps requiring each six-tenths of an ampere at 100 volts, or 60 watts during the interval. Suppose, also, that the lamps cost 40 cents each and that the "current" cost 15 cents per kilowatt hour, or .015 cents per watt hour. The cost of the energy is 5X60X100X.015=450 cents. Adding the cost of the lamps, the total cost of the light for the first 100 hours is 650 cents. The total light afforded is 5X16X100=8,000 candle power hours. The average cost of one candle power hour is 650÷8,000=.081 cents. By calculations of this sort the costs of a candle power hour up to 100, 200, 300 hours etc., were obtained for the lamps tested, using as data 20 cents each as lamp cost, and 15 cents per kilowatt hour for energy, these being values common in many localities at the present time. Curve 1 passes through the points representing the costs found at intervals up to 800 hours.

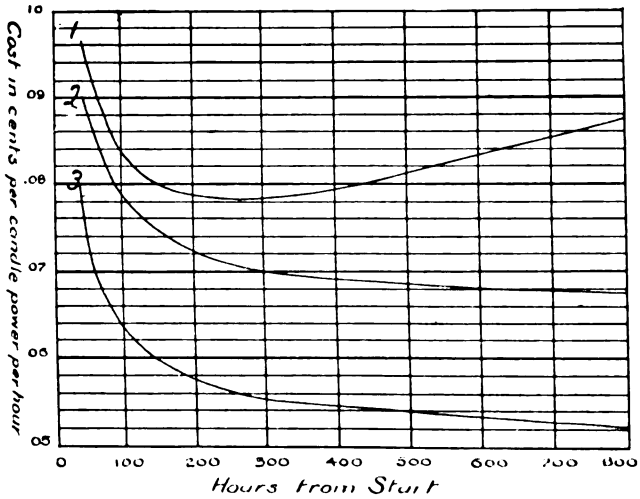

Fig 2

On examining the curve it will readily be seen that the cost of the light produced by these lamps under the conditions stated, decreases rapidly at first, then more slowly at up to about 275 hours, when it begins to increase and continues to do so to the end. If one wishes to light his premises to a given degree of brightness with lamps giving this curve, he can evidently save money by running the lamps for about 300 hours, and then replacing them by new lamps even though the old lamps might burn a thousand hours longer without breaking. If he should run them for 800 hours, the cost of his light, per hour, would be the same as if he had replaced the lamps at 80 hours. But he would gain by replacing at 80 hours, for during that time the light given by the lamps is clear and white, while at 800 hours their light is yellow and unsatisfactory.

Curve 2 is the economy curve of an ideal 16 candle power lamp of the same initial efficiency and at the same cost for lamp and energy, the ideal lamp being defined as one whose candle power neither increases nor decreases with age.

The cost of light from such a lamp also decreases rapidly at first, more slowly afterward. It has no turning point, but tends toward a constant minimum value after several thousand hours burning. Unfortunately such lamps cannot be made.

Curve 3 is also for an ideal lamp with the same data except that an initial efficiency of 3.44 watts per candle power is assumed. The difference in the costs shown by it and by curve 2 shows the saving secured by using lamps of higher efficiency, provided the lamps would maintain their candle power and efficiency. But unfortunately lamps decrease in these respects more rapidly as they are run at higher efficiency. The lamps of curve 1 for example could be run at an initial efficiency of 3.5 watts per candle power, but, while they would then afford light at a lower average cost at first, they would reach the minimum point (or "smashing point" as it has been aptly called) sooner, if indeed they would burn long enough to reach this point. It should be said here that the lamps tested were made some years ago and do not fairly represent the performance of the better lamps of to-day. Certain lamps tested within a year have shown a smashing point beyond 700 hours when run at about 3.5 watts.

This extended illustration has been given for the purpose of showing to lamp users the importance of the knowledge which may be gained by the use of a photometer, and is one of many reasons why a photometer should be provided and used in every central station or isolated plant which tries to secure economical results in incandescent lighting.

Benj. F. Thomas.

DOES THIS MEAN WAR?

The "hello girls" must learn telegraphy. The word has gone forth, and it will not be many months before the telephone wires through the entire state will be carrying telegraph messages.

After November it is probable that the Pacific Telephone and Telegraph company will become an active rival of the Western Union and the Pacific Postal Telegraph companies. With a complete plant doing the work of two companies, no extra expense for linemen and operators, the telephone company would make large profits transmitting telegraph messages.

At present the officers of the company refuse to say whether they are going to take advantage of this opportunity to utilize the full capacity of their plant.

"There is one thing you may be sure of," said John I. Sabin, who is the president as well as the general manager of the Pacific Telephone company; "that is, that it will not be long before candidates for positions to take charge of telephones will be required to be expert telegraph operators."

"Is it true that you have required all your girls to learn telegraphy?" was asked.

"Not all of them" he said. "We are going to make use of our wires to expedite messages by means of telegraphy. So the only ones whom we have required to learn the art are the girls employed in the 'Sunset' division."

"You see," he added, "the Western Union company held the coast rights to the Edison patents in the beginning. We held the Bell patents. Then the Western Union company disposed of its patent rights to us with the agreement that we were not to use our lines for commercial telegraphy during a given period. This period expires in November, 1896."

"Will you then enter into competition with the Western Union and Postal Telegraph companies in the transmission of messages?" was asked.

"I can't say anything about that now," said Mr. Sabin, "because I don't know."

"But you are well equipped for the work as the other companies, are you not?"

"As well equipped?" he replied. "Why, we have the best plant in the state today. No other company has nearly as good poles or wire. We would have to make absolutely no addition to our plant, since, for our own use, we are going to supply the offices in the different towns with telelgraph instruments."—*San Francisco Call.*

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CONDUIT ELECTRIC RAILWAYS.*

Interesting and Instructive Data on the Operation of the Ninth Street Line of the Metropolitan Railroad at Washington, D. C.

EXCELLENT SHOWING ON PRACTICAL POINTS.

The first public trip was made on July 29. From that date the horse cars were gradually withdrawn until August 15, when they were all displaced by the electric trains. The equipment consists of an open motor car, hauling in summer, an open, and in winter, a closed trailer. The weight of the summer train is 21,250 pounds, and the winter train 20,400 pounds. The number of trains in daily service has varied from twenty-two to twenty-six, the latter being the present number. The interruptions in service have been insignificant considering all of the conditions. Most of the delays have been from causes other than electrical, such as running into open switches, or derailment at the north terminus. The first serious delay was occasioned by a car of an intersecting cable road stopping too close to the crossing while an electric car was passing. The rope caught the plow, jamming the shank plates tightly into the crossing slot. This accident has not since occurred. A short-circuited plow stopped the line for some time one evening. The addition of fuses in the plow leads, and of a rheostat in the station, has since reduced the danger of delays from this cause to a minimum.

The most serious stoppage was from the burning out of a special insulator at a cable crossing. In designing the road it had been found impossible to place the regular insulators in complicated pieces of special work without impairing the strength of the track construction somewhat. A special insulator bolted to the bottom flange of the slot rail was designed for such places. It had an opening between the head of the bolt which holds the conductor rail, and the bottom of the slot rail, and this opening was filled with insulating material. A joint opened in this insulation allowing water to reach the bolt head. The leak created enough heat to burn away the insulation and to melt the bolt. In consequence, the short piece of conductor rail at the crossing dropped at one end, allowing a plow to ride on top of the conductor rail, and bend the bolts of about six regular insulators. These had to be replaced at once. These special insulators will soon all be replaced by recently designed ones similar in construction to the regular insulators, and from which no such trouble can possibly be anticipated.

These three delays are the only ones of any moment which have occurred in the first five months of operation. But few new cable, and even trolley roads, can show a much better record. If the appreciation of the public is a reliable guide, the line is certainly giving a most excellent service All forms of weather have been successfully encountered, except hard snow storms. Up to the date of this writing there has been only one light snow storm. It is idle to predict the effect of a hard snow on the operation of the line. It is no specially easy matter to contend with snowstorms on either cable or trolley roads. It takes hard work and good appliances to keep any line open under the worst conditions of weather, and the management feels that the same will be true of the Ninth Street line. But that the line can be kept open it feels confident. The heaviest kind of rainfalls have entirely lost their terror. It has been demonstrated that operation does not have to be suspended by the complete flooding of the tubes in comparatively long stretches. The leak if large can be taken care of by adding another generator, or by reducing the voltage, by passing the current of the flooded circuit through a water rheostat at the station. With a properly designed switchboard, and a water rheostat, almost all of the troubles of the conduit can be remedied at once without affecting the operation of the road.

*By A. Connett in the Street Railway Journal for February.

Banks of lamps connected to each side of the circuit and to ground, give a fair idea of the insulation of the line and equipment at all times. A fault in insulation on one side of the plow can be detected very readily with these lamps, by making an opening in the conductor rails and reversing their polarity on each side of the opening. The bright lamps will become black and vice versa when the defective plow passes the opening. If the lamps are in the car barn and the opening in front of it, the faulty plow can be detetected and changed at once.

On the Ninth Street line each side of each circuit is tested to ground every night by the engineer. If any abnormal leak is shown, it is almost invariably disposed of by putting a current on the circuit through the water rheostat. A positive short circuit while the line is in operation is handled in the same way.

From both a structural and economic standpoint a conduit is limited in size. The clearances, therefore, between the conductors and the walls of the tube must be small. This idea was prominent in the design of the Ninth Street line. Stiff conductor bars were used, and adjusted to a perfect line during construction; but when so adjusted they were fixed and capable of no movement, except the slight longitudinal amount necessary for expansion and contraction. Large insulators were used for mechanical rather than electrical reasons. Experience has shown that if any error in these insulators was made it was on the side of excessive rather than deficient strength. The principle of a sliding contact on the vertical faces of the steel conductor rails has proven highly successful. There is no appreciable wear yet on the conductor rails from the soft cast iron shoes pressed against their faces by the very light springs. That the company is satisfied can be inferred from the fact that they are now building the thirteen and one-half miles of their more important east and west line with the same construction.

The maintenance of sufficient insulation has always been regarded as the primary difficulty of an open-slotted electric conduit; therefore, the writer feels that any facts bearing on this question will be of interest. It was soon found that the insulation of the positive side of the circuit was much higher than that of the negative side. Each of the four circuits showed the same fact. To demonstrate conclusively whether this result was due to local faults, a section of the line of about two thousand feet long from the station was disconnected at a cable crossing, and each insulator inspected. This section was then tested and showed the same result as before. Besides, this section showed an insulation resistance on each side of about twenty times that of the entire line of forty thousand feet. This seemed conclusively to prove that the loss was surface leakage, distributed uniformly over the line. It was feared that the insulation of the negative side would continue to depreciate. But this does not seem to be so. The relative difference of insulation resistance between the positive and negative sides still continues, but their absolute values are fairly uniform for like conditions of the weather, and with no local faults.

Some tables are given showing values of insulation at different times. Each of the four circuits has approximately four miles of exposed conductors in the tubes, supported by fifteen hundred insulators.

INSULATION RESISTANCE IN OHMS.

Circuit Number.	October 17.		November 15.		December 6.	
	Positive.	Negative.	Positive.	Negative.	Positive.	Negative.
1	19,500	770	8,300	400	36,800	1,250
2	16,500	280	5,200	14	25,800	700
3	18,100	670	8,000	480	29,100	830
4	10,900	770	5,200	330	27,600	910

October 17 was a dry day; on November 15 it rained hard all day; and December 6 was dry and cold and there had been no rain for seven days.

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There was a local fault on circuit No. 2 on November 15 found in a rubber-covered cable connecting the conductor bars at a cross-over. Its test is therefore of no comparative value. Immediately after making the tests of December 6, the polarity of the leads on circuit No. 4 was reversed. The object of this was to see the effect on the insulation resistance. This circuit was changed back to its original condition on December 24 after taking the test. The table will show the result of this experiment.

TESTS ON CIRCUIT No. 4.

Date.	Resistance East Conductor.	Polarity.	Resistance West Conductor.	Polarity.	Remarks.
Dec. 6...	27,600 ohms	+	910 ohms	—	Reversed after test
Dec. 24...	280 "	—	2,500 "	+	" " "
Jan. 9....	5,000 "	+	780 "	—	

It should be stated that the low resistances were measured by readings on a special ammeter, and the high resistances by readings on a Weston voltmeter, up to, and including the tests of December 6. After that, the voltmeter was injured, consequently the ammeter was used entirely. If the insulation resistance of *both* sides of the circuit should fall to 250 ohms, the daily leak would amount to twenty kilowatt hours, which would take ten cents worth of coal to produce. As a matter of fact, the writer does not believe that the line leak on the Ninth Street road averages in cost one cent per diem.

The following table gives some idea of power and coal consumption. The figures for August and September are omitted because the records were not systematically kept in the confusion of starting a new road:

Month.	Motor car miles.	Trail car miles.	Total car miles.	Average daily kilowatt hours.	Average lbs. of coal used daily.	Coal per kilowatt hour.	Coal per car mile.	Watt hours per car mile.
October.....	91,541	91,164	182,705	3,092	13,343	4.31	2.26	524
November.....	86,444	83,638	170,082	3,028	12,720	4.20	2.24	534
December.....	95,303	95,303	190,606	3,377	13,616	4.03	2.21	549
December 1 to 18..	.....	.....	.....	3,262	12,477	3.83	....	...

The figures from December 1 to 18 are given, because the station economy was effected by having to run a second engine and generator a part of the time after the latter date, on account of the heavy holiday travel. This affected the monthly average, as the figures show.

The poor economy from an underloaded engine is well known. The following table shows it in a most striking way, and may be of interest:

Date—Dec.	Day of Week.	Hours of No. 1 engine.	Hours of No. 2 engine.	Total engine hours.	Kilowatt hours.	Kilowatt hours per engine hour.	Coal used	Coal per Kilowatt hour
14	Saturday.....	20.5	.....	20.5	3,605	176.	13,500	3 73
15	Sunday.....	19 75	.....	19.75	2,585	131.	11,400	4.41
16	Monday.....	20 5	.....	20 5	3,405	166.	12,600	3.70
17	Tuesday.....	20.5		20.5	3,555	173.	13,200	3.71
18	Wednesday...	20 5	9.	29 5	3,590	122.	15,600	4 35
19	Thursday....	20.5	16.5	37.	3,590	97.	16,800	4 68
20	Friday.....	20 5	14.17	34.67	3 340	96.	18,000	5.39
21	Saturday ...	14 67	18 17	32 84	3,685	112.	17,100	4 64
22	Sunday.....	19 75	....	19 75	2,700	136	12,000	4.44

The following table gives the operating expenses for November. This month is chosen because repairs of equipments had not reached any fair amount until then. The December figures would have been given also if they had been ready;

Officials and clerical help.....	$ 705.16
Car service, switchmen, car cleaners, etc.....	4,499.37
Car, equipment and plow repairs, etc.....	1,198.12
Motive power.....	919 53
Maintenance of way, including all track and conduit expense.....	155.93
Light service.....	74.53
Repairs to buildings	25.65
Sundry expense.....	89.17
Total operating expenses.....	$7,667.46
Operating expense per car mile.....	4.5 cts
" " " motor car mile.....	8.87 "

The trail car mileage was not quite equal to the motor car mileage in November, therefore the expense per train mile cannot be given absolutely. The cost per motor car mile is sufficiently close to the train mile expense for all practical purposes. It will be seen that the operating expenses are exclusive of taxes, accidents, and insurance. Figures for these items are not available.

The cost of motive power per motor car mile is 1.06 cents. The cost of producing a kilowatt hour is 1.01 cents.

These figures demonstrate that so far the Ninth Street line is commercially successful.

BICYCLE EPIDEMIC OUT WEST.

The San Francisco Examiner prints the following description of a new style of electric railway:

A working model of a "bicycle railway" has been in operation in the yard of the Pacific Rolling Mills for several weeks, and from the tests given it the inventor, Dr. Clarke of Santa Cruz, is satisfied that a speed of fully 100 miles an hour can be attained with ease and safety.

Electricity is the motive power and is supplied to the operating dynamo by the ordinary overhead trolley system. It is the plan of the inventor, however, in case a line is built, to supply the power to the motors from a copper wire below the surface of the rails.

According to the plans each car will have only two wheels. They are without flanges and very broad on their bearing surfaces. They will run in two broad and flat-headed rails, running parallel and set with about an inch of space between them. The rails are very much like the ordinary "I" beams used in constructing the modern fire-proof buildings. In the slot thus formed between the rails a heavy bar of steel will extend from the bottom of each end of the car, and to them will be attached strong pulleys to run on the under side of the flange of the rail.

These pulleys are designed to prevent the car from leaving the rails and to insure stability. They are so arranged that they turn and run true on any curve and guide the heavy wheels.

The driving-wheel of the motor can be made any size that may be desired or suggested by the amount of power supplied. The greater the power the greater can the diameter of the driving-wheel be made and correspondingly increase the speed. It will be geared with a series of cog-wheels to the dynamo and so arranged by the gearing that the speed can be increased or diminished, according to the work to be done or the power at the command of the motor.

The rails take up little space and the whole track will be not much more than a foot wide. The track can be built at much less cost than the ordinary railway road-bed. Ties are not necessary nor is it required to grade a roadway. The track can be laid along on trestles that need be but little more than a row of piles set ten or twelve feet apart. A stringer can be laid along on top of them and to that the rails fastened. By this method the expense would be small to lay a railway across the roughest kind of country.

The railway is not intended for carrying bulky or heavy freight, as the cars must necessarily be narrow to reduce the side leverage as much as possible and prevent them from breaking away from the guide-wheels under the flanges of the rails. The inventor's object is cheapness in construction and the quick delivery of light material and passengers.

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ALTERNATING CURRENT METER.

Professor Brownell Takes Issue with Doctor Monell and Points Out Defects of Latter's Newly Invented Device.

CANNOT MEASURE ELECTRICITY BY OHMS.

I was much interested in reading Dr. Monell's article in the January 15th number of THE ELECTRICAL JOURNAL entitled "Alternating Current Meter," because of the new electrical theories advanced and because of the fine example of jumping at conclusions. Ohm's law, apparently, was not considered and the system, if it could be put into operation, would lead to some peculiar and even disastrous results. The author's definition of a proper faradic or alternating current dose seems to be the *energy* which the patient can readily bear without pain, and the measure of this energy is recorded in *ohms* or in terms of resistance. The principle used he describes as follows: "In my method * * * it is simply considered that the energy at first wholly absorbed within the secondary rheostat, when perception of the current is nullified on its passage through the rheostat to the patient, is transferred from the controlling grasp of the rheostat to exert an equivalent energy within the tissues when the descent of the movable in the tube reduces resistance proportionate to its descent, *and in exact* proportion raises the current strength in *that part of the circuit* between the applied electrodes."

In the first place energy is *work* and not *resistance* nor *current;* and in electricity work is the product of current into E. M. F. or the square of the E. M. F. divided by the resistance of the circuit. In the first illustration given, it is assumed that perception occurs when the secondary rheostat stands at 700,000 ohms and that the current is sufficiently strong for the proper dose when it stands at 100,000 ohms. Therefore the energy of the 600,000 ohms cut out of the circuit has been transferred to the tissues, so the author argues. Let us attempt to demonstrate this by means of the well-known laws of the circuit.

In the first place, the E. M. F. of the secondary coil will vary but little if the resistance of the secondary circuit is reasonably high and if there is no change in the conditions in the primary circuit. Let us assume that this E. M. F. in the author's illustration was 50 volts, and that the resistance of the patient was 5,000 ohms and that of the secondary coil 2,000 ohms. The current was first felt when the rheostat stood at 700,000 ohms and the resistance of the whole circuit was therefore 707,000 ohms. The current was $\frac{50}{707000}$ amperes and the total energy expended in the circuit was $\frac{50 \times 50}{707000} = .0035$ watts. Of this only $\frac{5}{707}$ was expended in the patient while $\frac{700}{707}$, or practically all of it was expended in the rheostat. When the current was sufficiently strong the rheostat stood at 100,000 ohms and the total energy of the circuit was therefore $\frac{50 \times 50}{107000} = .0233$ watts. Of this $\frac{5}{107}$ or .001 watts was expended in the patient. This is only $\frac{1}{4}$ of the energy which was originally expended in the 600,000 ohms of resistance which were cut out of the circuit, instead of being equal to it as is stated in the article.

Suppose now some other physician were to take the record "dose 600,000 ohms" and apply it to a similar case with a similar or even the same coil and an equal number of cells of the same kind of battery. But suppose that these batteries had been "run down" somewhat—the author says this will not affect the accuracy of the dose record—so that the E.M.F. of the secondary coil is only 40 volts instead of 50 volts. This would cause first perception to take place with a lower resistance in the secondary circuit. Suppose this to be reduced to 600,000 ohms. Then when a "600,000 ohm dose" was administered the rheostat would be entirely cut out. The total energy of the circuit would then be $\frac{40 \times 40}{7000} = 0.23$ watts, of which $\frac{4}{7}$ or 0.164 watts would be expended upon the patient. This is 164 times as much energy as the first patient received and yet the difference in the rheostat readings or the 'dose" was the same in both cases.

From Ohm's law again, we have the fact that "the fall in pressure along a conductor is proportional to the resistance passed over." Therefore in our first example the E.M.F. at the electrodes would be determined by the proportion T:50::5000:10700 or would be 2.34 volts. In the second example the E.M.F. at the electrodes would be determined by the proportion T:40::5000:7000 or would be about 29 volts or 12 times what it was in the first instance.

If first perception had occurred at a point between 600,000 and 700,000 ohms the E.M.F. and energy to which the patient would have been subjected, would have been between the first and second values found above, and if it had occurred above 700,000 ohms these values would have been lower than the first values found. Therefore this system insures similar results only when batteries, coils, primary rheostats and first perceptions, as indicated by the secondary rheostats, are all precisely alike—a thing which will practically never occur.

The author's statement that "there is no parallel to this precision of record to be found in the literature of faradic electricity" may be true, but a system which permits of such vast errors as are shown above is not worthy an instant's consideration.

Respectfully yours,

H. G. BROWNELL.

Louisville Manual Training High School.
Louisville, Ky., Feb. 10, 1896.

NOT GOOD FOR BAPTISMS.

The *Mining and Scientific Press* thus sums up the uses to which electricity is applied: "It enters into the preparation of what we eat and drink and wear and there are many articles of utility now produced by its aid. The residents of many cities in the United States have their houses protected, lighted and heated by electricity. They go to their places of business in cars run by electricity, the elevator by which they reach their offices in high buildings, or the machinery in their factory, is run by electricity. The bell which summons them to church is run by electricity. Electricity brings the news to them from all parts of the earth, stamps their letters, automatically sounds the alarm in case of fire, rings the door bell, cooks the food and fans them while eating it. When they go to the dentist their teeth are drilled and filled by electricity, and minature electric lamps are now constructed for the use of doctors in diagnosing diseases. The patient swallows a lighted lamp which illuminates his person so as to enable the physician to make a correct diagnosis. The barber cuts or singes the hair by means of electricity, the streets are lighted and the farm cultivated by it. By means of it we can talk to our friends 500 or 1,000 miles away, and hear their voices as distinctly as though they were in the same room." We might add that people have been married by it, and some few have died by it, but not voluntarily. People and papers that insist on having fun over the gymnastics of which electricity is capable, will please meditate—by electricity—on this last suggestion.

COMBINATION LAUNCH AND SAIL BOAT.

H. J. Burton, of Minneapolis, is contemplating the building of an ideal boat. It will be a combination of an electric launch and a sail boat to be propelled either by electricity or wind, as the occasion may require. It is Mr. Burton's idea to build a 34-foot launch and to fit it out with a powerful storage battery motor and a two-blade propeller. The sails would be arranged in the plan of a double sail canoe, a main mast and mizzen mast. The boat would be fitted for all sailing except close into the wind, when the electric power could be used.

Mr. Burton's country home at Deephaven is already fitted up with a powerful dynamo with which the electric lights at his house are supplied. The capacity of this plant is much greater than is exacted of it and the surplus force could be used in charging the storage battery in the boat. Mr. Burton is not sure that he will complete his boat the coming summer, but may do so.

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HERE, THERE AND EVERYWHERE.

Telephone and Telegraph.

The French government is seriously considering the advisability of establishing a direct cable between the United States and France, via the Antilles. The project is under the consideration of the Committee of the Chamber of Deputies, which corresponds to the Committee on Ways and Means of our Congress. The full text of the proposed law is given in the current number of the *Revue Internationale de L'Electricite.*

It is claimed that the telephone is more generally used in Norway than in any country in the world. Notwithstanding the fact that 70 per cent of the country can not be cultivated and that another 24 per cent is in forests, Norway has one telephone exchange for each 7,800 inhabitants and a telephone for each group of 40, which is over eight times the proportion for this country.

The Western Union Telegraph Company is preparing to go underground in Syracuse, N. Y., a contract having been let for constructing subways on several streets, leading from the New York Central's station. The company also wishes to connect with the West Shore, and the Delaware, Lackawanna and Western railroad stations and have asked for a franchise.

The longest telegraph line in the world above ground and without a break has just been completed in Australia. It runs from Rockhampton, in Queensland, to Broome, in Western Australia—a total length of over 6,000 miles.

Light and Power.

The third largest electrical power plant in the United States is to be erected in Mariposa County, California. The largest, as is well known, is at Niagara Falls, the next in size being at Folsom, California. This new plant is to be placed at Horseshoe Bend on the Merced River, four miles from Coulterville, and will be able to furnish 3,500 electrical horse power. The dam will be placed in the river four miles above the station and will be 35 feet in height and 65 feet long. The head of water at the plant will be 93 feet. At first there will be installed three 500 horse power generators and as the demand increases the capacity will be enlarged. Power will be probably taken by about one hundred mines in the vicinity which are now paying for steam power at the rate of $12 to $15 per month, while electric power will cost them but $5 per month.

Columbus, Ohio, has awarded a contract for city lighting to a new company which will erect a plant to cost in the neighborhood of half a million. It is known that it will cost about $75,000 to place the wires under ground in the district bounded by Naghten street and Livingston avenue and Fourth street and the river. The grounds and buildings will not cost less than $50,000, the steam plant and the electrical machinery is estimated in the neighborhood of $150,000, and the various lines throughout the city will approximately cost $125,000.

City Engineer Paul Schulze, of Utica, N. Y., is preparing plans for the substitution of electric power for hydraulic power in the operation of the Genesee street bridge. The hydraulic apparatus hitherto used, consumed 10,000,000 gallons of water daily from the Erie canal and was not returned thereto, and Superintendent of Public Works Aldridge has notified Mayor Gibson that the practice would have to be discontinued.

Charles R. Reynolds, electrical inspector for the Hartford, Conn., Board of Fire Underwriters, reports that in 1895 there were but two cases of fire that could be attributed to electric wires as against twelve for the year 1894. He also reports that of 815 fires reported by the Electrical Bureau of the National Board of Fire Underwriters, 113 were due to the crossing of telephone and signal with light and power wires.

The lighting committee of the city council of Logansport, Ind., have reported that the new municipal lighting plant is proving a source of profit and revenue to the city. The receipts from private lighting have paid over one-half of the operating expenses during the first year, and the balance sheet shows that in four years the city will have the plant paid for and will not be in debt for the same to the extent of a dollar.

A Washington, D. C., hotel, the Normandie, has an extremely flexible lighting plant. It consists of two engines and two dynamos. Ordinarily each engine runs a generator, but, in case of necessity, the dynamos are so mounted on their bases that they may be slewed around, and with special belts, which are kept in readiness, either dynamo or both, can be run from either engine.

The Chicago Edison Company has just completed arrangements by which the *Inter-Ocean*, which uses 150 horse-power for motors and current for 1,000 incandescent lights, can be instantaneously connected with either the Harrison street or Market street stations of the company. This avoids a possibility of a stoppage from a break down at either station.

The sub-committee on railways and telegraphs of the city council of Toledo, Ohio, have prepared an ordinance providing for the putting underground, before January 15, 1897, of all wires except trolley lines in the district between the river and Michigan street and the Cherry Street bridge and Swan Creek. No opposition to the measure has developed.

Edward S. Cramp, the Phi'adelphia ship builder, has been made a director of the Potomac Electric Light and Power Company of Washington, which corporation has been authorized to build a plant in Georgetown. The Cramps will furnish the steam machinery, and the General Electric Company will furnish the electrical equipment.

The extensive cotton and woolen mills of Messrs. Dickey & Sons, at Oella, Maryland, are to be operated entirely by electricity. Two generators operated by turbines will furnish the current and each of the four buildings will have its independent motor. This installation takes the place of the hydraulic plant now in use.

The plant of the Wayne Electric Company, at Wayne, Pa., was totally destroyed by fire on the 1st inst. The loss is $60,000, and not only has the town of Wayne been left in darkness, but the towns of St. Davids, Radnor, Villa Nova, Stafford, Devon and Berwin which were supplied from the station, are sufferers as well.

The city of Portland, Oregon, has been paying $10,000 per annum to a private company for city arc lights. It has been decided that this expense cannot be maintained and the city council is now wrestling with the problem of how many and what lights can be dispensed with.

The German Government has given the Siemens & Halske Co., of Berlin, a contract for an electric boring plant to be used at the state salt mines at Hallein. The plant will consist of a turbine coupled direct to a continuous current generator and two boring machines.

The penitentiary at Albuquerque, New Mexico, has a surplus of 100 electrical horse power and the commissioners have closed a contract with a local company to lease this power for $6 per horse power per month, the minimum quantity to be used being thirty horse power.

The Fort Wayne Electric Co. have sold and shipped to the local plant at Canton, Miss., one 40-light arc and one 750-light incandescent machine. They also have sold to the Mutual Electric Co. of San Francisco one 80-light arc dynamo.

During the year 1895, without doing anything in particular to encourage electric power installation, the Edison Illuminating Company of New York City has seen this branch of its service increase nearly 50 per cent. or 3,600 horse power.

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The town of Berlin, Conn., will be lighted free of charge by the Berlin Iron Bridge Company, which thinks that this course will not only be of benefit to the town but will, in a measure, add to the safety of the immense plant

In France, outside of Paris, there were on January 1st, 1896, 438 central electric stations, as against 328 on January 1st, 1895. These stations have a total horse power of nearly 50,000.

The consolidated Light, Heat & Power Company, has been organized at Oliphant, Pa., with a capital stock of $12,000.

Kharkoff, Russia, is to be lighted with 6,000 incandescent and 500 arc lamps.

Railways.

The Westinghouse Electric and Manufacturing Company has recently received orders to equip an electric railway in the "Isle of Man," the little island near the coast of Ireland, which has been made famous by Hall Caine, the great novelist; another order for electric railway apparatus for the City of Coventry, England; and a third order for electric motors and railway generators for Capetown, South Africa. The company is also about to ship an order for electric railway apparatus to Bangkok, Siam, India.

The *Manufacturers' Record* states that one of the best built and equipped railway systems in the South, the Texas Midland Railway, will change its motive power from steam to electricity. The road is owned by Mrs. Hetty Green, the famous woman of financial circles, and her son E. H R. Green is President, with headquarters at Terrel, Texas. The road is about 100 miles in length and if the change is made will be the longest trolley line in the world.

The company which sought to introduce the trolley into the city of Brussels and which failed to convince the municipal authorities that the trolley was the proper system, has presented a new set of plans to the authorities in which they propose to use an underground system similar to that of Buda-Pesth.

The Montgomery Suburban Street Railway Company, with a capital stock of $100,000 has been formed at Montgomery, Alabama, and has secured control of the West End Electric line which will be extended and improved. Alexander Troy, G. B. Shelhorn and others are back of the new enterprise.

The Rockford Traction Company has been incorporated, with a capital stock of $300,000, to build an electric railway at Rockford, Ill. C. H. Moon, H. L. Jewell and W. F. Burns are the incorporators.

CONSOLIDATED EXTORTION.

Now that an appropriation of $800,000 has been made for contract of public lighting in Philadelphia, in the face of a storm of opposition from the press, *The Call* relieves its feelings as follows:

"Professor William D. Marks, who has just severed his long and honorable connection with the Edison Electric Light Company, voices an opinion that will strike the stock-watering promoters of consolidated projects as being little short of revolutionary. And the fact that this opinion emanates from a man of broad financial experience, mature judgment and unquestioned capacity, does not tend to lessen its drastic force. "I am a believer," says Mr. Marks, "in a principle of reducing the prices to the public so as to divide about 8 per cent. dividends and have about 4 per cent. surplus to be devoted to the maintenance of the plant." Mr. Marks here alludes to the prices of electric lighting, but the terms are broad enough to be applicable to street-car fares, gas-lighting rates and other charges bearing on public purse. "I do not believe," he continues, "that a corporation dependent on a public franchise can pursue any other course successfully. Consolidation for the purpose of extortion I regard as a self-destructive policy."

This is not the opinion of a financial novice making tentative incursions into the domain of finance. It is the firm and grounded belief of one of Philadelphia's ablest financiers. It carries with it great weight, if not conviction, to those audacious operators in various fields whose policies it antagonizes. And it is the strongest kind of an indorsement of the very views that *The Call* has been urging for years. Suppose the Traction managers had adopted a similar line of policy. What would have been the result? Would it be eight cent fares and wretchedly inadequate accomodations, as to-day—or would an era of prosperity smile on the Traction system under three-cent fares? The trouble is that instead of incorporating a policy like that outlined by Mr. Marks, involving the systematic decrease of rates in a degree proportionate to increased earnings, the Consolidated Traction Companies resorted to the less admirable expedient of stock inflation as a means of concealing the enormity of their profits. The Traction managers are not the only offenders in this respect. The practice of stock-watering is common to many enterprises of a corporate nature. It is the misfortune of the Traction Company, however, that public attention is at this time concentrated upon it to the exclusion of all others. In this the winter of their discontent we beg leave to commend to them the strong words of Mr. Marks: "Consolidation for the purpose of extortion is, I believe, a self-destructive policy."

ELECTROLYTIC SEPARATION OF METALS.

The persistence with which E. T. Smith and D. L. Wallace have been following up the subject of the electrolytic separation of metals during the past few years is praiseworthy to the highest degree, for it is by no means a particularly fascinating one to the average man, and the results when attained do not appeal to a very wide circle, though it is probable that they will yet have an important bearing on the gold industry. They have succeeded, says the *Electrical Review* (London), in separating completely from other metals, by using cold solutions of the double cyanides, cadmium, mercury, gold and silver; but from 12 to 14 hours were always required for the purpose. Smith working with Spencer has accelerated the deposition of both mercury and silver by heating the electrolyte to from 65° to 70° C. Following up this hint, Smith and Wallace now show that by working at a temperature of 65° C. mercury can be separated quantitatively from cadmium, zinc, nickel and cobalt in cyanide solution, containing a little free potassium cyanide by using a current density of from 0·02 to 0·08 (preferably 0·06) ampere per 100 sq. cm. of electrode surface. Similarly, and at the same temperatures, gold can be separated from cobalt, arsenic, zinc and nickel, by a current of 0.1 ampere, or from copper by one of 0·07 ampere per 100 sq. cm. of electrode surface. Silver can be separated from zinc, nickel and cobalt, as well as from copper and cadmium, by a current of 0·04 ampere per 100 sq. cm. The precipitates are stated by Smith and Wallace to have been pure, and the time required ranged from 3 to 3½ hours. There yet remains the problem of determining the conditions for the separation of silver from gold and of mercury from gold and silver in cyanide solution —*Engineering and Mining Journal.*

A number of practical electricians propose to organize an electrical society in Utica, N. Y. Among those interested are W. C. Balda, H. G. Hatfield, E. D. Goshaw, William Brigham, C. W. Roberts, J. G. Fitzgerald, F. B. Donater, W. G. Carl and A. L. Scranton. At the preliminary meeting Mr. Goshaw was chairman and Messrs. Fitzgerald, Hatfield and Scranton were appointed as a committee on organizations.

The metal glucinium, hitherto a chemical rarity, is likely to come forward as a useful material, especially in electrical work. It is only twice as heavy as water, and is, therefore, even lighter than aluminum. It is a good deal less extensible than iron, and has an electric conductivity greater than that of copper. It is more durable than iron. At its present price, $17.83 per pound, is is one-tenth the price of platinum, weight for weight, and 1-106th the price, volume for volume.

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POSSIBILITIES OF THE ELECTRICAL FURNACE.

The new chemistry of high temperatures, whose applications are likely to be very numerous, is being rapidly evolved. In the reverberatory electrical furnace with movable electrodes, which he devised no longer ago than 1892, M. H. Moissan has obtained temperatures sufficient to produce the diamond, to crystalize metallic oxides, to reduce those hitherto refractory metals hitherto infusible, to distill lime, silica, zirconium and carbon and to cause an abundant volatilization of such metals as platinum, copper, gold, iron, manganese, chromium and uranium. In this furnace, the electric arc is passed directly over the subject under experiment, which is held in a crucible in a chamber of lime. Chromium is reduced from the sesquioxide to an unoxidizable metal, which can be filed like iron, takes a fine polish, and has the advantage over ferro-chromium for alloys of being free from carbon. The great possibilities of chromium alloys can now be effectively studied. Molybdenum, previously infused, can be obtained in considerable quantities; and is found to have a fine grain, and to be capable of being filed, forged at a red heat, and alloyed with iron in a steel that can be tempered. Tungsten, even more infusible than chromium and molybdenum, is readily liquified under the electric arc, and obtained in a very pure state. Uranium is readily reduced from its oxides, and when slightly carburetted it has the property of striking fire with flint. Of vanadium, known before as an impure gray powder, small quantities have been obtained as cast metal, having a crystalline and brilliant fracture. The current of a dynamo driven by an engine of 40 horse-power scarcely sufficed to melt it. Titanium was obtained with currents of 100 to 300 horse-power, and has unexpected properties-taking fire in fluorine, decomposing water at a bright-red heat, and, very curiously, burning the nitrogen at a high temperature. These simple bodies are all from crystalized compounds with carbon, boron and silicon, and some are so hard as to cut the diamond. Possibly others besides chromium may give new properties of value to iron.

WHERE MICA IS MINED.

The enormous expansion of electrical science has produced a corresponding output in mica. Of the world's supply of mica North Carolina, U. S. A., produced about 100,000 lb. per year; New Hampshire, U. S. A , a trifle over 25,000 lb.; South Dakota, 18,000 lb.; New Mexico, 1,000 lb. The North Carolina product commands the highest price in the market. There are few more beautiful sights than a mica mine in South Dakota. When the mine is lighted by a torch it is a veritable palace of Aladdin, the mica flakes reflecting innumerable points of light in every direction, which with the creamy white of the containing walls, transform the gloomy tunnel to a hall of dazzling brilliancy. It is held in what are technically known as books, ranging in size from the tiniest prayer book to a huge dictionary. These are contained in huge veins of albite, a white crystalline rock of a creamy soft whiteness. The books as they come out, some of them larger than the largest dictionary, are easily split into leaves. One of the largest pieces of mica known came from the South Dakota mines in the Black Hills. It was a quarter of an inch thick, so clear that a newspaper could easily be read through it, and measured about 44 inches square. The two principal uses of mica are in stoves and as insulators in electricity. It has what is termed an "infinite resistance." It is flexible, nearly or quite transparent, and capable of being divided into leaves, so fine and delicate that it will cast iridescent reflections which approximate the thinness of a soap bubble. Few natural products are carried on with such wasteful expenditure of material as mica. For the lucky individual who will discover a means of utilizing the enormous waste, a fortune awaits. It has no superior as a non-conductor of heat. If a practical method of boiler covering were devised from mica it would leave nothing to be desired.

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LARGE RAILWAY GENERATORS SOLD.

The Westinghouse Electric and Manufacturing Company of Pittsburgh, Pa., recently shipped two of the largest electrical generators for the operation of an electrical railway that have ever been turned out anywhere. These two machines were of 1,500 H. P. each, and they were contracted for by the Nassau Electric Railway Company of Brooklyn, N. Y. Last summer the Westinghouse Company constructed and delivered to the same railway company three generators of 750 H. P. capacity each, making the total capacity of the electric railway plant 5250 H. P., one of the largest in the country.

The new generators are of the style known as engine-type, being direct connected to a Cooper Corliss engine running at a speed of 75 r. p. m.

CHICAGO ELECTRICAL ASSOCIATION.

On February 7th, in room 1737, of the Monadnock Block, Mr. W. R. Garton read a paper on "Lightning Arresters," before the Chicago Electrical Association.

The paper described, step by step, the development of the arrester and the causes which led to its employment. The manner of installing these necessary articles of electrical equipment was fully explained and many faults in present methods, due to carelessness or ignorance of employees, were clearly pointed out and exact reasons were given to show why these methods were faulty.

Various types of arresters for telegraph and telephone lines, railway currents, low tension direct current, high tension direct and alternating current lines were described and the salient points of each pointed out.

VALUE OF ELECTRICAL TRAINING.

An English electrician maintains that the overcrowding in the ranks of electrical engineering is a good thing for the public. He regards it as conducive to the spread of applied electricity to encourage electro-technical education as much as possible. The larger the number from which the best men are selected by the inevitable process of competition, the better. The unfit go to the wall, but they carry the light of thier knowledge into other professions and callings, and public interest in electrical matters is thus stimulated. Another writer on the same subject says that young electricians should not lose sight of the fact that grit and tact have quite as much to do with their success as electrical knowledge. This is shown in the case of a student who had passed his electrical course creditably, and was in due course told to present himself at the offices of one of the chief London companies. As he thought that the chairman and the members of the board would be there to receive him he attired himself in clothes of surpassing beauty. He was sent straight to the engine room. If there is one thing detested in a works, it is a dude, and the engineer told him promptly to go and break up coal. He explained that he had not contemplated beginning work that day, and begged to be allowed to commence on the next. At six o'clock next morning he turned up in clothes that ought long since to have been given to the deserving poor. The engineer, however, was not yet sure of his man, and pointing to a broom, he told him to go and sweep out a back yard. Now, the student grasped the situation, and returned to his taskmaster to say he had never before realized the skill required wielding a broom; he perceived he had still much to learn; was there not another back yard near that wanted sweeping out? He was clearly not to be drawn, so he was at once set to work in earnest. The tale reached the manager's ears, and was told by him to the directors. The character shown by the young electrician in the way he accepted the position taught every one, from the dirrctors downward, that they had with them a man who had the stuff in him out of which great engineers are made. They never lost sight of him, and he is now on their staff and has a future before him. As showing, on the other hand, how easily a man may throw away his chances, it is related that a fellow student, who had also done well at college,

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THE WOLF TURNED SHEPHERD.

(Dedicated to Our Blue Contemporary with apologies to La Fontaine.)

A wolf who found in cautious flocks
His tithes beginning to be few,
Thought that he'd play the part of Fox,
A character he thought he knew.

He got the dress—could he but mock
The shepherd's voice, he'd lure the flock;
He thought he could.
That spoiled the whole affair—he's spoken;
His howl reechoes through the wood.
The game is up, the spell is broken.

At last the bubble breaks;
There's always some mistake a rascal makes.
The wolf like wolf must always act;
That is a very certain fact.

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was drafted into some corporation works, where he was engaged for a certain term to do testing, etc. When the time expired, he waited for a month and no engagement offered itself. One night, just as he was dressing for a party, a letter was brought to him. He was late, and so threw the letter aside and forgot all about it for ten days. He then found it was from his former employers offering him the superintendentship of the works. He applied forthwith, but another man had been appointed three days before.

RAILWAY LIGHTING.

William Garstang, superintendent of motive power of the Big Four lines, expresses the opinion that within a few years passenger trains will be lighted by electric lights as generally as they are now equipped with air brakes. He says the Chesapeake & Ohio is successfully lighting its trains with electricity. This company has built a plant at Covington, Ky., where the storage batteries of each coach or car are charged sufficiently to light the car the round trip between Cincinnati and Jersey City.

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

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Conditions of Trade.

Is not the United States ahead of the world in the commercial development of electricity? Cannot the people of the United States hold their own in selling what they manufacture if conditions are even? Do we sell as much electrical machinery to foreign countries as other commercial nations do? If so, are the figures at hand? If we do not sell as much, why not?

The above queries were put recently to a well posted man by a student of commercial and economic problems, and we have thought the questions important enough to engage the attention of the electrical people and their friends. There is no manner of doubt that we are ahead of the world in the commercial applications of electricity, and there is less of a question about the ability of our selling agents to compete when conditions are equal. The next question—do we sell as much electrical machinery as other commercial nations do—is a more difficult one to answer, and we have not the figures at hand to do so. But we can think of at least one or two reasons why we might not do as much foreign business as—England for instance. We will take the position that we are selling apparatus right in the British Isles, and in Germany and France, our only other competitors. But that fact does not prove a rule.

A very strong factor bearing on this question is that of government paternalism. Whenever the United Kingdom assumes a protectorate over a foreign part, immediately a company quasi-governmental in character, is organized and chartered to act in official commercial relations with it. In cases like the South American states, while England's tenure and influence are commercial only, the British government assumes a protectorate over her own merchants, helps them in every conceivable way by ship subsidies, by extensions of consul powers and the like, and when her merchants' interests are at stake, Great Britain sends along a few steel cruisers as a collection agency. The same thing is true to a less extent with France and Germany, but England's aggressiveness in this direction and the undisputed success of her merchants brings her into prominence.

There is another reason why our own electrical manufacturers as a class are not equipped to do large foreign business. With the exception of perhaps three or four corporations, there are few if any American concerns that have the capital to await the slow payment methods of Latin and Latin American and Oriental buyers who would be our chief patrons. This ought not to be and we are quite sure that it will not be for long. The electrical people have taken too many chances. They have started, as a rule, with too little capital; in proof of which even the most casual observer will have noticed that the panic that began three years ago was ushered in by numerous failures of electrical manufacturers. They were the first to feel the tightening of the money centers.

The remedy for these conditions is self-evident. Business men should apply the same conservative policy to the electrical business as to any other. The rewards are certainly as great as in any other directions. But who would think of going into the railway business or the coal business, or the business of manufacturing gas, or any other, without having closely calculated as to the amount of money required to carry on the business contemplated to the extent intended, and without first knowing that the capital was at hand.

There are some hard months before the electrical people, as well as before the country generally. Times will not "boom" until after the presidential election. We are quite sure that then things will go well for a long while. But in the meantime let us conserve every energy, sail close to the wind, with sails well reefed, and rest dead sure that when the tariff tinkerers and jack leg politicians get through with their nefarious practices, and when the present National Administration either quits meddling with the finances of the country or is relegated to the eternal shades of oblivion, things will come our way at a high potential lick.

* * *

The Necessity for Trained Experts.

Notwithstanding the reputation that the average American has for hard, shrewd business sense, it must be confessed that when we consider the history of the electrical business, a good deal of this reputation is unearned. The "mysteries" of the science, the expression of what a few men have accomplished in the way of wealth, the vast progress that has been made even within the decade in all electrical directions, and the universal application of electricity in some form—all these things seem to have won from even our best and most conservative business men their usual habits of care, and they have often invested their money in electricity in a way that would seem criminal to them, in any one else, in the ordinary channels of trade.

These same reasons have led men to follow precedents in the installation of new electric plants, when even the original plants taken as models have been unwise and unprofitable investments.

In many directions the methods of operating in commercial electricity have been vastly improved recently. One of the most radical improvements is the placing of business men at the head of business institutions, and of keeping the inventors and technical men in the work shops. What we need now is the proper recognition of engineering talent, and the proper application of well known principles in installing electrical machinery. In other words, every electrical installation ought to be so planned that it will be financially profitable, and this cannot be done except by competent, well-trained men. Hardly two plants in the country present the same conditions. Machinery, ideal in all particulars for one installation, would be wholly out of place for another. One plant is intended to operate a thousand arc lights in a park system, all to be on at once and off together. Another is intended to do a little all night lighting, a little moon light schedule lighting, a little incandescent lighting, and to supply a little power for motors. Imagine the different conditions that are presented in these two cases. Unless the units are properly provided, unless the plant is properly arranged with a view to the labor required, unless the fuel question is properly met, and unless a dozen other equally important factors are taken care of, there can be but one result of such an installation and that is loss of money—continuously and unavoidably. And as competition with gas, steam and oil becomes closer, the losses will be greater.

Every man before putting in an electric plant of any kind or

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size and for any purpose whatever, ought to employ an electrical engineer—not a bell hanger who can use big terms and talk in a manner thoroughly mystifying to the prospective employer—but an engineer of standing and reputation. Before employing such a man, one should know that he possesses three qualifications, namely, honesty, horse sense and technical knowledge, and the greatest of these is *honesty*. It is impossible for one to lose money by having a capable engineer. He will prove the cheapest as well as the best part of the whole lay out. He will save money on the first cost by economy in specifying, buying and building. He will save money every hour that the plant is in operation thereafter, by so planning it, that it will give the greatest amount of service of the particular kind required for the least money, and his compensation will not amount to a drop in the bucket when the results are summed up.

Let us inaugurate an epoch of scientific practical as well as theoretical electrical engineering.

The Motor Vehicle Contest.

We have the pleasure to present to our readers in this issue, an elaborate abstract of the engineering report of the *Times-Herald* Motocycle Contest. The *Times-Herald* will print the report in full in its Sunday edition of February 16th, and we are indebted to the *Times-Herald* for advance proofs which enable us to bring before our readers promptly, one of the most interesting and instructive scientific studies we have had for a long time.

For the first time since the horse was accepted as the basis or unit of locomotive power for road vehicles without track, and certainly for the first time since there was likelihood of the horse being supplanted by mechanical or other power, we have in this report some definite figures upon which to base a judgment as to whether or not steam, gas, gasoline, oil and electricity—or any of them—are controllable to an extent that will make them successful commercial competitors against horse power. Mr. Kohlsaat's grand conception which resulted in the motor vehicle contest of last Thanksgiving day has thus to be credited beyond any other event, circumstance or condition, with whatever of progress we make in this field of science.

We will not attempt, at this time to dilate upon the results of these tests, preferring rather to give them to our readers without further comment than to call attention to their importance.

* * *

The British Institution Militant.

It is really unfortunate that Mr. Edison should have prematurely divulged his plans for an electrical coast defense. The French technical papers have had their flippant fling at "Edison L'exterminateur," and now from the remarks in the current number of London *Lightning*, it seems that Mr. Edison's plans have shaken the staid and ponderous British Institution of Electrical Engineers to its very foundation.

True, Dr. Hopkinson, in his address did not specifically mention Mr. Edison's plans, but *Lightning* does not fail to make an invidious comparison between Dr. Hopkinson and Edison, and reading between the lines and judging by the enthusiasm with which a proposal to place the Institution at the service of the government was received, must surely endow all thinking men with a lurking suspicion that the first British warship that approaches this coast with hostile intent, will convey a notable delegation from the Institution, which will be prepared to effectually side-track the first stray streak of Mr. Edison's coast defense electricity that may make its appearance.

By all means, the American Institute of Electrical Engineers should meet and devise some scheme to insulate the Monroe Doctrine.

* * *

Let There Be Peace.

In another column will be found a reported interview with General Manager Sabin, of the Pacific Telephone Company, on the whilom delicate subject of the telegraphic possibilities of the telephone plants of the conntry. Mr. Sabin's talk is the roughest handling we have seen of this subject up to this time and savors some of the bull in the china shop.

We are not monopolists in the offensive sense, but we would regard with much misgiving and would deprecate without mincing the reasons, any warlike demonstrations between these giant corporations, the Bell Company and the Western Union. The electrical business is bad enough now in all conscience. The depressing influences of a war between these interests would settle the matter of profits and the values of electrical stocks for a long time to come.

The electrical people have done or allowed to be done a good many fool things of late years. Heretofore the Bell people and the Western Union people have kept out of foolhardy and rash undertakings. It is a late day to begin. Wise councillors in business will be mindful of the classical warning that "Whom the gods would destroy they first make mad."

* * *

Electro-Therapeutics as a Science.

The announcement made elsewhere in these columns, that the Section on Physics, of the congress of the French Association for the advancement of science, will, at its meeting in Tunis in April, devote a large portion of its time to the consideration of electro-therapeutics, shows the deep interest which the study of this fascinating branch of electricity has awakened in the medical and scientific world.

Although the earliest practical application of electricity was for medical purposes, that branch of the science stood practically still during all the grand march of commercial electricity during the past two decades, and it is only within very few years that much sustained scientific attention has been given to it. Now the best minds in the electrical as well as the medical profession are hard at work on the physical and physiological aspects of the subject. This concentration of genius and energy can not fail to have the effect of carrying far forward the science by which electricity is to be devoted to the grandest of all uses, the amelioration of the ills of humanity. We predict that electro-therapeutics will be monumental in its scope and importance when the art of electrocution has taken its place with the Spanish inquisition and the stake.

* * *

Alternating Current Measurement.

In another page of this issue we publish a criticism on Dr. Monell's recent paper on "Alternating Current Measurement," by Prof. H. G. Brownell, late Chief Instructor of the National School of Electricity, now Principal of the Manual Training School of Louisville.

We took occasion to announce in commenting on Dr. Monell's paper, at the time of its publication in THE ELECTRICAL JOURNAL on Jan. 15, that we should criticise the paper at a later day. Prof. Brownell has so clearly voiced some of the questions that presented themselves to us at the time, that we are willing to allow his criticism to stand for us.

* * *

Is This the Temperance Question?

A correspondent in the *New York World* who signs himself "Americanus Sum," has taken the remarkable ground that electricity as used in medicine is a stimulant and that, like all other stimulants, its use will be followed by a depression and reaction and will inevitably leave the patient worse off than before. We will now perhaps be confronted with the electrical toper and what visions of high license, local option, prohibition, ten ampere hip pockets, not to mention the ubiquitous boot legger toting around contraband batteries, the prospect does conjure up!

* * *

The city of Ragatz in Switzerland has two central stations and the competition between them for the lighting of the principal avenues of the city is so keen that the city pays nothing for the light. A war of that kind in America would hardly go to such lengths. Trusts are too fashionable.

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An Elastic Scheme of Lighting.

A paragraph has been going the rounds of the press which states that the city of Springfield, Ill., pays a private corporation $113 per annum for each street arc light and also pays seven per cent on an investment by the company of $100,000, making the rate for each lamp about $125 per annum.

The above is correct, but the rate is not excessive when it becomes known that the plant, which did cost $100,000, and which is one of the finest in the state, will, at the expiration of five years, become the property of the city absolutely without the payment of another dollar.

* * *

Why Not Give Keely a Show?

Senator Hill has introduced a bill into congress to authorize the construction of an electrical cruiser, equipped with a system of motors and propellers invented by one Richard B. Painton, or the equipment of one of the present naval vessels with the system.

In view of the fact that congress has already experimented on two occasions with the untried schemes of enthusiastic inventors and made a signal failure in each instance it is unlikely that any more vessels of the Vesuvius and Katahdin class will be ordered by congress. Some long-haired enthusiast in the senate will bring up the Keely motor next.

* * *

While there is a good deal of gossip going about the country anent the unripeness of electricity for steam road purposes, let us not forget that three of the greatest roads in this country tried electricity last year, and the results were most striking. The New York, New Haven and Hartford made a test on one of its excursion branches near Boston; the Pennsylvania equipped a cross-country section in New Jersey that would not pay with steam; the Baltimore and Ohio placed two of the strongest locomotives in the world in service to haul by electricity ponderous freight and passenger trains through its new tunnel under the city of Baltimore.

* * *

The *Financial Times* of London wants telephone communication between London and Berlin, and the *Electrical Engineer*, in commenting on the idea, remarks that it would be a boon to Emperor William when he particularly wants to free his mind to his august grandmother. Perhaps William would rather have his grandma write, as it is well known the old lady has a mind of her own to unload on occasions. At any rate if telephonic communication is established between Berlin and London with a special view to royal use, the whole mechanism wants to be armor plated or well padded.

* * *

A weather bureau inventor proposes that each telegraph pole along the tracks of railroads be equipped with a red incandescent lamp and a switch. In case of accident one of the trainmen would go to the nearest pole and throw the switch which would light up all the lamps along the line as well as one in the train dispatcher's office.

When an American railway corporation can be induced to turn its right of way into a thousand mile torchlight procession for the safety of the traveling public the millenium will be close by in the bushes.

* * *

We are patiently waiting for some genius of the Keely variety to rig up a combination wind wheel and sail to be used in ocean traffic. The mechanism could be employed as a sail when the wind was in the right quarter, and as a wind wheel to run a dynamo for charging storage batteries at other times. These batteries could be used for propulsion purposes when the wind was dead ahead or too close up. No charge for the suggestion.

* * *

A San Francisco genius has patented an antiseptic diaphragm to be placed over the opening in the transmitters of telephones. Can it be that the ubiquitous microbe proposes to use telephone lines as electric railways in order to get around?

The degenerate and ungodly managers of the electric light plant at Aberdeen, South Dakota, have found that the capacity of their plant is overtaxed, and have decided that the churches of the town can best stand the deprivation of light pending the arrival of additional machinery. We dare to suggest that if the church members will "let their light so shine" a little more generously, the electric light company will let their light follow suit.

* * *

London physicians are still decrying electric illumination and are predicting a total, universal blindness for future generations. It would be well for some one to call the attention of these pessimists to the fact that there is such a luminous body as the sun, brighter even than electric lights, and shines frequently—outside of London.

* * *

An Anglo-Indian electrician has devised an apparatus for the self-electrocution of crows. By all means let us have all the benefits of the Oriental innovation. Perhaps the apparatus could be made so attractive as to encourage a suicide epidemic among our English sparrows.

* * *

The town of Rockford, Ill., is to increase its electric railway facilities. Is this an implied hint to Schweinfurth that his exit is being encouraged? Or, are the good people of Schweinfurthville preparing better accommodations for outsiders to gain entrance to "Heaven?"

* * *

The Berlin Iron Company of Berlin, Conn., has offered to light that town free of charge on the ground of civic pride. We look for this spirit to be emulated next by the lighting combine of Philadelphia.

* * *

The ticket collectors of the London and Southwestern Railway have been fitted out with small portable incandescent lamps with pocket batteries in lieu of hand oil lamps. This is the apotheosis of Mr. W. H. Preece's long and useful career.

* * *

It is worthy of note that the Avenue de l'Opera in Paris is to be again lighted by electricity instead of gas. Many years ago the famous thoroughfare was lighted by the Jablochkoff candles. "The first shall be last!"

* * *

An electric small arm has been invented which is fired when a circuit is closed by the hammer falling. It is not warranted, however, not to go off when it is not loaded, and thus is a great need still unfilled.

* * *

"Electrolysis of the conscience" is a new manifestation of the subtle fluid. It can be best studied in municipal governing bodies.

THAT COMPREHENSIVE CODE.

A recent message announcing the loss by fire of a ship at sea was conveyed in three words of Scott's cable code: "Smouldered! hurrah! hallelujah!" "Smouldered" stands for "the ship has been destroyed by fire;" "hurrah" for "crew saved by boats," and "hallelujah" for "all hands saved—inform wives and sweethearts."

CHICAGO CONTRACTS.

A goodly representation of the skirmish liners has been in Chicago for a week or so, looking after the West Park and Lincoln Park contracts. Most of the big companies have men on the ground.

Long-distance transmission of power has at last invaded Egypt. A plant is to be established near Assouan, on the Nile, where a water power of 44,000 horse power is available.

The subscription price to THE ELECTRICAL JOURNAL is $2.

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BOOK REVIEWS.

PHYSICAL LABORATORY MANUAL.—By H. S. Chute, M. S., author of "Practical Physics," etc., and Teacher of Physics in the Ann Arbor High School: D. C. Heath & Co., Boston.

The importance of precise training in the laboratory is being recognized more and more every day, and for those who are training for the technical professions the value of laboratory work from the very beginning of the study of physics can not be overestimated. It is therefore a pleasure to find a work on physics which starts out with the hypothesis that the student knows nothing of these first principles from his school text books unsupported by any practical experience.

Prof. Chute's book is designed to provide laboratory practice from the very beginning for the pupil. It insists on a careful record being kept by the pupil of every step that may be taken and of the results attained; no trivial circumstance must be disregarded, but must be noted, thus entailing habits of the closest observation. In the matter of simple measurements, a subject that is generally treated in a perfunctory way, the author goes into minute details, illustrated with experiments, which, when carried out must leave a clear understanding of the subject in the student's mind. The apparatus to be used must, in many cases, be improvised by the student from simple materials, and no problem is presented, that with a clear understanding of what has already been studied, can not be readily solved. The mechanics of solids and fluids, heat, magnetism and electricity, sound and light are all entertainingly, concisely, and clearly presented. With each subject a number of problems are presented, the apparatus necessary is specified, the method of operation described and a number of queries on the subject are propounded, the answers to which will indicate the student's understanding of the subject. A number of valuable appendices with directions for making apparatus, on laboratory operations, with numerous tables for reference, which will be found to be of much value to others than students, and a price list of laboratory material complete the volume.

As a text book for beginners it leaves nothing to be desired and is a valuable contribution to educational work.

A PORTABLE, SELF-ATTACHING DRILL.

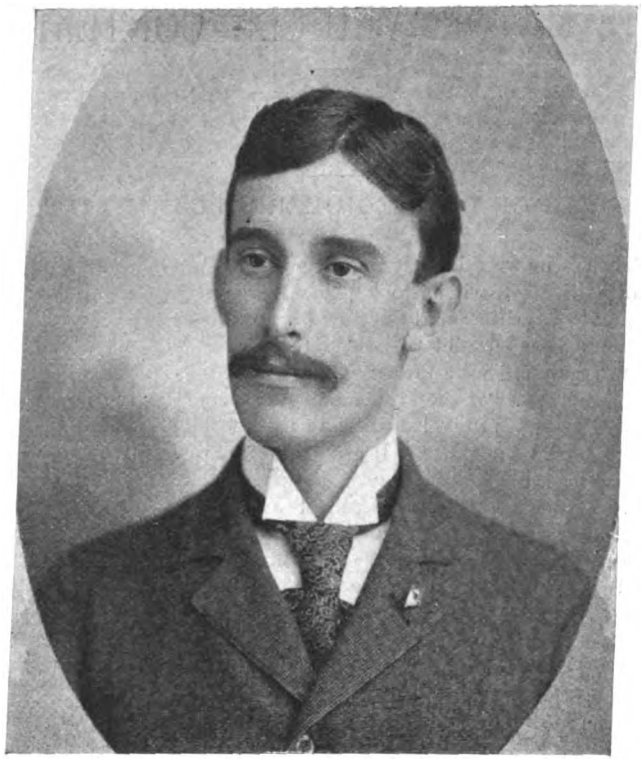
The *Trade Journal Review* describes a novel drilling machine which can be attached to the side of an iron or steel ship and held there firmly by means of a powerful electro-magnet and used where it would be impossible to attach it in any other way.

As a rule, these machines must be bolted to the surface to be drilled, and in most cases it would be inadvisable as well as impossible to have the holes to attach the drilling machine.

This new drill motor which, when suspended over the side, attaches itself firmly to any part of the smooth surface by the magnetism created by the currents of electricity used for driving the motor. It is, in fact, a powerful electro-magnet. The feet of the machine are the parts that cling to the surface, and these adhere so firmly to the ship that the drilling can be effected with perfect ease. When the hole is thus formed the drill is disconnected and the motor detached by turning off the current, and it is slung to another part to commence another hole. If this system of drilling should ever be extended largely, the problem of making the holes in a ship's plates and angles in situ may be solved, and the separate punching be altogether discontinued. But that seems a far-off prospect. The punching bear may rest secure for many years to come. It will be long ere its useful functions are superseded by any kind of drilling machine, electro-magnetic or otherwise.

Mr Allan C. Bakewell, of New York, has just been elected vice-president and general manager of the Interior Conduit and Insulation Company, in place of Mr. E. W. Little, recently resigned.

The subscription price to the ELECTRICAL JOURNAL is $2.



EDWARD A. BARNES.

The subject of this sketch, though quite a young man in years, is old in experience and service in the electrical business. This photograph was taken about two months ago. About a month prior to that time Mr. Barnes had become fully awake to the error of his ways and had turned over a new leaf under the soft suasion of one of Indiana's loveliest daughters—hence his sweet and "pat hand" smile.

Mr. Barnes has been in the electrical business for thirteen years, and has done about everything there is to be done, from the elevating and refining employment of selling apparatus to building it in the shops. His first service was in the Bergmann Company, New York. After two years spent there in standardizing and testing instruments, he formed a partnership with some friends to install Westinghouse plants in the West. This connection brought him an engagement as electrician to the Richmond Light, Heat and Power Company, where he remained until 1889 when he entered the construction department of the then Ft. Wayne-Jenney Electric Light Company. The change in name and scope of that corporation brought promotion to Mr. Barnes, who now holds the important position of assistant superintendent under Mr. J. J. Wood. Mr. Barnes' special function—and he has brought it to be a fine art—is the handling of materials that enter into dynamo construction. It is said that he can make a piece of metal or mica go further than any man in the business, and we all know what economy in construction amounts to.

Mr. Barnes is 31 years of age, one of the pleasantest and most agreeable fellows socially, married (now) and we predict that one of these days his head will punch a hole through the top.

RAPID TRANSIT IN PHILADELPHIA.

A very unusual and amusing circumstance—amusing, that is, to all but the principal actor—occasioned a block on the Wayne Avenue trolley line, Germantown, above Wayne Junction, one day recently. The motorman on one of the cars of that line, who had been holding his hand to his jaw in a peculiar fashion for several minutes while his car sped along, suddenly turned off the motive power and signalled to the conductor that he would like to talk to him. There was a brief conference, and then the motorman jumped off his car and ran around the corner and disappeared. The conductor jumped down into the street, and stood slapping his arms across his chest.

Several more cars came up and stopped behind the first. The motormen and conductors deserted their posts and gathered around the first conductor. He said something to them and they all laughed. The passengers began to think that another strike had been declared. But after a time the motorman came back with a look of relief upon his countenance "Well, I got it out," he yelled to the conductor, "but she hurt a bit, you bet," and he held up a huge molar which the dentist had pulled from his jaw. Then the cars went on.—*Philadelphia Record.*

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THE MOTOR VEHICLE CONTEST.

The Efficiency of Various Motive Powers Under Equal Conditions—Study of Various Fuels—Study of Single and Double Motors.

REPORT OF THE ENGINEERING COMMITTEE.

Those who were directly in charge of the *Times-Herald* Motor Vehicle Contest, which took place November 30th, last, were willing to be criticised at the time for not pushing the contest to an immediate verdict without reference to any more stable results than popular approval of a "good race." They had before them the results of the French and other contests of the kind, and they were fully advised as to the shortcomings and weak points of those contests. It was therefore in full view of past experience aided by their own judgment, that they decided to provide a series of mechanical tests of efficiency of the various vehicles entered in the contest, in addition to the severe "road race" which we remember so well.

In our description of the contest, published in the issue of December 15th, we sufficiently described the mechanism employed to make these auxiliary tests, and we will not enter into that part of the subject again, but will go at once into the meat of the matter.

The report of which this article is an elaborate abstract, is signed by Mr. J. P. Barrett, chairman, and by Messrs. Leland L. Summers and John Lundie, Engineering Committee.

The report, of the committee begins with a survey of the past, a study of the horse-power unit and the methods of testing a horse. This phase of the report leads up to the accepted figures of horse-power capacity at 33,000 foot pounds per minute. Of horse-power measurement, the committee state that "the determinations actually made of the pull required of a horse in pulling a vehicle are not very numerous nor authentic, as, owing to the fact that the pull is apt to be irregular, many difficulties are encountered in measuring it and no great accuracy is attainable." Without doubt the committee would add that the difficulties and obstacles in the way of measuring mechanical power for vehicle purposes are hardly less, since they met with many conditions that marred the accuracy of their work.

In order that the same conditions might exist for all gasoline vehicles under test, the committee supplied gasoline from the same barrel, the density of which was found to be 0.688. No effort was made to obtain a particular density of gasoline, as it was deemed best to use that ordinarily to be obtained from the retail dealer. Cost of gasoline was estimated at 2 cents per pound in deducing the results shown in the appended table.

The cost of electrical energy was estimated at 10 cents per kilowatt hour. The storage batteries were assumed to have an efficiency of about 75 per cent, making a cost per horse power hour delivered to the motor, of 10 cents

MAXIMUM PULL OF VEHICLES.

In order to still further compare the performance of the motocycles with that of the horse, efforts were made to determine the maximum pull which the vehicle could exert as compared to that of the horse. It is evident this would only be of interest in determining the performance of the vehicle when operating under extremely unfavorable conditions, and in this connection the committee add that the vehicles submitted were all designed for a light passenger service and not to exert a heavy pull, so that a medium pull exerted at a high average rate of speed was the object sought rather than a heavy pull under adverse conditions. For determining this feature, the pull on the motocycles was increased until the limiting conditions were reached, with the results shown.

HEAVIEST PULL EXERTED.

The heaviest pull exerted, viz.: that with the Duryea vehicle, amounted to only 187 pounds as compared to 400 pounds which a single horse could exert. It was not possible in any of the tests made to slip the driving wheels, so that the traction in all cases was ample, and if a greater driving power had been available by means of reducing gearing or otherwise it would probably have been possible to obtain a correspondingly high result. It the case of the belt driven machine of the Benz type, the limit was usually reached when the belts slipped. The Lewis motocycle was equipped with a special reduction gear, enabling a very heavy pull to be produced. An effort to obtain this heavy pull from the vehicle resulted in the breaking of the driving chains. Under these conditions it is hardly fair to consider the results as the best obtainable. In the machines directly geared any attempt to obtain heavier pulls than those given resulted in stalling the motors. The pull obtained with the electrical vehicles was, of course, only limited by the heating effects of the excessive current required.

GAS ENGINE VEHICLES.

It will be observed that there is a wide difference in the consumption of gasoline by the various engines submitted. This is naturally to be expected when the types of engines are considered. In the case of the Lewis and the Haynes & Apperson vehicles, the cycle is such as to give an explosion every revolution, the piston itself uncovering the exhaust port, this type of engine being variously known in stationary practice as the Single, Sintz or Day cycle. The exhaust from these engines was so densely laden with unconsumed carbon that an exhaust pipe and fume blast were required to convey the fumes from the testing-room. This simply bears out the well-known fact that this type of engine, giving an explosion for every revolution, while possessing many advantages, has a very low economy due to the improper combustion of the fuel supplied. The other motors presented were also all operated upon the Otto cycle. In the Benz type of motor the gasoline was thoroughly carburetted before being admitted to the cylinder, while in the Duryea and others the gasoline was vaporized directly at the cylinder. The results obtained therefore enabled a partial comparison to be made between these methods of utilizing the gasoline.

It is to be regretted that owing to a derangement of the igniting mechanism in the Duryea engine higher power tests were not possible with this vehicle. It is a well-known fact in gas engine operation that the economy of the engine at light loads is, if anything, inferior to the steam engine under similar conditions. In the application of the gas engine to a motocycle the economy is particularly low for the reason that a considerable proportion of the power is sacrificed in driving the mechanism. Owing to this feature the consumption of gasoline per horse power hour at rim of the wheel is quite large when the motocycle is operated under an ordinary load; for example, requiring about seventy-five horse power for its propulsion, it is evident that as high as one and one half horse power may be required in the engine in order to overcome the friction of the mechanism.

If the motor is designed to give three or four horse power at the rim of the wheels, the motor is lightly loaded under the ordinary conditions, and the economy, as a result, is very low. In this connection, the Benz type of vehicle presents another interesting feature of comparison. These vehicles are provided with but two ranges of speed when the gas engine is running at its normal speed, and, in order to increase the range of control, the supply and proportion of the mixture of air and gasoline is varied. This is accomplished by a regulating valve controlled from the driver's seat. The explosive force of the mixture is readily controlled in this way and a wide range of speed is thus given to the vehicle without the necessity for complicated mechanical devices for speed regulation. This simplicity and ease of control may, however, be purchased at the expense of economy, as will be apparent from the tests at various loads.

VIBRATORY INFLUENCES.

The location of the driving engine and the method of transmitting the power to the driving mechanism greatly influences the amount of vibration there is to the vehicle. In the Benz type of vehicle, the single cylinder engine, giving an explosion at every second revolution, is mounted with the cylinder at

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TABLE No. 2.—POWER AND EFFICIENCY TESTS OF MOTOCYCLES.

NAME OF MOTOCYCLE.	No. of Run.	Speed in Feet per Minute.	Pull Exerted, Pounds.	Horse-Power Exerted at Rim of Wheel.	Horse-Power Consumed in Mechanism.	Total Horse-Power Developed in Cylinder.	Mechanical Efficiency.	Gasoline—Pounds Consumed per hour.	Gasoline—Pounds Consumed per Horse-Power Hour at Rim of Wheel.	Foot pounds at Rim of Wheel per pound of Gasoline.	Cost per Horse-Power Hour at Rim of Wheel—Cents.	Efficiency. H.P. Output, H.P. Input.	Heaviest Pull Exerted. Pounds.	REMARKS.
De La Vergne R. M. Co., New York (Benz Motor)	1	619.	37.	.70	.71	1.41	.50	3.24	4.63	428,000	9.26			
	2	1,000.	51.8	1.57	1.40	2.97	.53	4.45	2.83	700,000	5.66		162.	
Duryea Motor Wagon Co., Springfield, Mass. (Own Motor)	1	432.	83.8	1.10	.59	1.69	.65	4.01	3.64	545,000	7.28			
	2	434.	88.5	1.16	.59	1.75	.65	3.78	3.24	623,000	6.48		187.	Trouble with igniter.
Haynes & Apperson, Kokomo, Ind (Own Motor)	1	376.	23.1	.26	.61	.87	.30	5.78	21.8	91,000	43.60			
	2	796.	39.3	.95	1.28	2.23	.43	5.75	6.4	327,000	12.8		119.	Two cylinders in use—one only supplying power.
Lewis, G. W., Chicago, Ill. (Own Motor)	1	353.	49.9	.53	.53	1.06	.50	3.29	6.20	319,000	12.40			
	2	491.	17.	.25	.65	.90	.28	3.28	12.8	155,000	25.60		109.	Chain broke.
Macy, R. H. & Co., New York (Roger-Benz Motor)	1	521.	52.1	.83	1.48	2.31	.36	3.22	3.90	515,000	7.80			
	2	945.	87.2	2.50	2.68	5.18	.48	4.90	1.96	1,010,000	3.92		103.7	Belt Slipped.
Mueller, H. & Sons, Decatur, Ill. (Mueller-Benz Motor.)	1	423.	92.1	1.18	.61	1.79	.66	3.50	2.96	669,000	5.92			
	2	540.	42.3	.69	.77	1.46	.47	3.87	5.60	354,000	11.20			
	3	564.	38.6	.66	.81	1.47	.45	3.77	5.71	347,000	11.42			
	4	984.	73.4	2.18	1.57	3.75	.58	3.40	1.57	1,268,000	3.14		135.4	
	5	1,168.	34.7	1.23	1.86	3.09	.40	4.15	3.37	588,000	6.74			
						Total H. P. Developed in Motor.		Electrical Input H. P.	K. W. Hours Supplied to Batteries per H. P. H. at Rim of Wheel.	Foot Pounds at Rim of Wheel per K. W. H.				INPUT. Volts. / Amp.
Morris & Salom, Philadelphia.. (Lundell Motor)	1	1,025.	25.5	.78	34.	1.12	.70	1.36	1.74	1,138,000	17.4	.57		97. / 10.5
	2	2,015.	29.	1.78	.68	2.46	.72	2.90	1.63	1,215,000	16.3	.61		96. / 22.5 — Test ended by trouble with bearing.
Sturges Electric Motocycle Co., Chicago, Ill. (Lundell Motor)	1	370.	41.	.41	.21	.62	.66	.99	2.42	818,000	24.2	.41		35. / 21.
	2	892.	42.	1.14	.39	1.53	.74	1.94	1.70	1,165,000	17.0	.59	121.	69. / 21.

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right angles to the axle of the driving wheels. The effect is to cause considerable vibration, and, unless special means are adopted for counteracting this, it is transmitted to the body of the vehicle, resulting in more or less discomfort to passengers at the time of starting, although afterward it is not so noticeable. In the Duryea vehicle the two driving cylinders are parallel to the axle of the driving wheels and any reactive effect from the cylinders produces a vibration transversely. The vehicle of Messrs. Haynes & Apperson is provided with two cylinders, one on each side of the crank shaft, and the reactive effect is greatly diminished.

From the consideration of these questions it would appear necessary to use more than one cylinder to eliminate vibrations, and, preferably, these cylinders should be arranged upon opposite sides of the driving shaft in order that the reactive effect may be entirely balanced and the vehicle freed from vibratory effects when the engine is running, though not propelling the vehicle.

ELECTRIC VEHICLES.

In considering the electric vehicles, it is evident, that in using a variable current from the storage batteries, as the discharge rate is increased beyond the normal, both the life and efficiency of the battery will be diminished. In the Morris-Salom vehicle the batteries were rated at fifty ampere hours, with a discharge rate of five amperes. When discharging at a rate of twenty-two amperes it is evident that the available capacity of the cells will be greatly diminished. It is perhaps unfair to assume, therefore, that the efficiency will remain constant. While the mechanical efficiency is higher with a heavier load, the electrical efficiency as a whole may be diminished. The correction necessary for these factors will depend so largely upon particular conditions that no allowance has been made for them. The assumption of 75 per cent efficiency in the batteries will be a fair average for normal conditions. The cost of electrical energy will also vary with the conditions, so that both of these factors must be considered in estimating the cost of operation. The heavy depreciation of the batteries when subjected to excessive discharges will also constitute a charge against cost of operation.

COMPARISON OF SINGLE AND DOUBLE MOTOR.

An interesting comparison may be made between the Sturges vehicle and that of Messrs. Morris & Salom. Both of these vehicles are equipped with the same type of motor, the Sturges vehicle being propelled by a single motor of three horse power, while that of Messrs. Morris & Salom is propelled by two one and one-half horse power motors. A single axle with the wheel solidly mounted, the carriage being carried by the journals on this shaft after the pattern of a car journal, is the method of driving adopted in the Sturges vehicle, while in the Morris & Salom the pinion on the motor is geared directly to the driving wheels, the wheels being provided with ball bearings, and every effort being made to diminish friction.

The tests indicate that with the best workmanship possible the two motors have but a slightly higher efficiency than the single motor, though the mounting of the single motor is in a measure crude. The electrical and gear losses with two motors would, of course, be greater than with a single motor. The advantages of the series parallel control of the motors when storage batteries are used and may be grouped to regulate the voltage, does not, therefore, seem necessarily to be a factor of sufficient inportance to warrant the adoption of two motors. Apparently the only other factor to particularly commend this arrangement is the elimination of a differential gear for enabling the wheels to travel independently of each other when curves or corners are being turned. In driving with a single motor of any type, it is evidently necessary to provide a means of driving the wheels independently of each other, as otherwise a binding action on curves would result. The method adopted, in almost all the gasoline vehicles presented, consisted of some form of differential gear, each driving wheel of the vehicle being separately connected by means of a sprocket chain to the same counter shaft.

TABLE No. 1—DETAILS AND DIMENSIONS OF MOTOCYCLES.

NAME OF MOTOCYCLE.	WEIGHT. (Light.)			Wheel Base, Inches.	Gauge Driver, Inches.	Gauge Steering, Inches.	RADIUS. (Compressed).		Position of Drivers.	Nature of Tires.	Nature of Bearing.	Fuel or Energy Supplied.	No. of Cylinders.	Diameter Bore Cylinder, Inches.	Stroke of Piston, Inches.
	Driver, lbs.	Steering, lbs.	Total, lbs.				Drivers, Inches.	Steering, Inches.							
De La Vergne R. M. Co., New York..... (Benz Motor).	1,250.	430.	1,680.	66.75	.....	.....	23.75	18.25	Rear	Solid rubber	Roller	Gasoline	1	5.125	6.625
Duryea Motor Wagon Co., Springfield, Mass. (Own Motor).	728.75	478.75	1,207.5	57.56	55.06	53.75	22.875	18.75	Rear	Pneumatic	.....	Gasoline	2	4.	4.5
Haynes & Apperson, Kokomo, Ind. (Own Motor).	829.	421.	1,250.	54.	55.25	55 56	17.85	17.9	Rear	Pneumatic	Ball	Gasoline	2	4.	4.
Lewis, G. W., Chicago, Ill.... (Own Motor).	900.	780.	1,680.	56.6	46.6	46.5	22.9	16.7	Rear	Solid rubber	Roller	Gasoline	1	5.	5.
Macy, R. H. & Co., New York ..... (Roger-Benz Motor).	1,440.	385.	1,825.	67.	52.	52.	23.8	17.9	Rear	Solid rubber	Roller	Gasoline	1	5.	7.
Morris and Salom, Philadelphia..... (Lundell Motor).	1,260.	390.	1,650.	49.	44.25	36.1	19.8	14.25	Front	Pneumatic	Ball	Storage Battery	Two motors	.....	.....
Mueller, H., & Sons, Decatur, Ill..... (Mueller-Benz Motor).	1,251.5	384.5	1,636.	73.07	50.2	47.8	24.	18.4	Rear	Solid rubber	Roller	Gasoline	1	5.5	6.25
Sturges Electric Motocycle Co., Chicago, Ill. (Lundell Motor).	2,085.	1,450.	3,535.	65.	57.	57.	25.125	23.25	Rear	Solid rubber	Plain	Storage Battery	One motor	.....	.....

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RESULTS OF TESTS.

Table No. 2 gives the actual data and reduced results of the tests. These results may not seem to meet preconceived views, and it may therefore be well to briefly analyze the results in order to indicate what may be deduced from a close consideration of the wheel problem.

PRACTICAL QUESTIONS ANSWERED.

One naturally seeks an answer to such practical questions as, What kind of a bearing ought I to use? What tire is best suited for certain work? What ought to be the diameter of a wheel for efficient service? And others of like nature. The limits of this report will not permit of more than an indication of the bearing of these experiments upon such questions. The following results may, however, be deduced from a consideration of the above data:

Table B—Pulls per 1,000 pounds of total load required to overcome lack of resilience in wheels under examination. (See tests 1, 3, 5, and 6.)

5.23 pounds on steel tire.
4.34 pounds on solid rubber tire.
8.5 pounds on pneumatic tires inflated.
14.6 pounds on pneumatic tires deflated.

Let it be noted that these pulls, being due principally to the material of the tire when the rest of the wheel is made, are not reduced by leverage as in the case of axle friction, as the moment used in overcoming the resistance is the same as the moment of the resistance.

As before mentioned, the axle friction, acting as it does, near the center of the wheel, is overcome by a pull which is inversely proportional to the radius of the wheel. In order, then, to properly compare axle frictions they should be reduced to pulls at equal distances from the center of the wheel. Deducing, then, from experiments we have:

Table C—Pulls per 1,000 pounds of load on bearings of Collinge axles reduced to uniform radius of 12 inches. (See tests 1, 3, and 5.)

18.7 pounds with steel tires.
7.2 pounds with solid rubber tires.
5.7 pounds with pneumatic tires.

HOW TIRES AFFECT RESULTS.

The question is naturally asked, What have the tires to do with the result?

This leads to the consideration of what carriage builders call "set" and "gather" in wheels, both being designed to compensate for the distortion of a vehicle in operation. The "set" is a vertical adjustment of the axle, so that when the wheels are under working load the tread of the tire will be horizontal. The "gather" is a lateral adjustment of the axle, so that when the wheels are under average traction they will be parallel to the direction of motion of the vehicle.

In the case of a steel tire, unless the axle and tire adjustment is perfect, there is induced in the axle a side thrust which accounts for the abnormal axle friction shown above with the steel tired wheels used

In the cases of the solid rubber and the pneumatic tires the tire allows a more or less perfect adjustment to be taken naturally.

The loads in tests 1, 3 and 5, table A, were practically the same and the axles were identical, and in the matter of axle bearing friction the same co-efficients apply. Thus with the pneumatic tires the co-efficient of 5.7 pounds per thousand at a radius of twelve inches, table C, represents bearing friction and very little, if any, thrust friction.

Reduced to the radius of the bearing, the friction figures 120 pounds per 1,000 pounds, giving a co-efficient of friction between surfaces not too well lubricated of 0.12, which corresponds with the result of well-known friction experiments.

The difference between 18.7 pounds on the steel tire wheel and 5.7 pounds on the pneumatic, or thirteen pounds, represents the pull per thousand pounds at a radius of twelve inches necessary to overcome the action of side thrust.

Thus the elimination of side thrust is a much greater factor in the reduction of power consumed by the wheels of a vehicle than the reduction of the friction of vertical bearing on the axle.

TABLE A—WHEEL RESISTANCE TESTS.

Number of Test.	Nature of Axles.	Nature of Tires.	Mean Diam. of Bearings. INCHES.	Radius of Wheels Loaded. INCHES.	Weight of Pair of Wheels. LBS.	Total Load including Wheels. LBS.	Pull at Tire Due to Axle Friction. LBS.	Total Pull at Tire Producing Uniform Motion.
1	Collinge	Steel	1⅛	24.5	68	659	5.4	8.84
2	Ball Bearing	Steel	1¾	21.75	....	452	....	2.86
3	Collinge	Solid rubber	1⅛	18.9	75	657	2.64	5.49
4	Ball Bearing	Solid rubber	1⅛	24.2	....	645	....	2.36
5	Collinge	1¾ inches Pneumatic (inflated)	1⅛	22.5	67	657	1.78	7.37
6	Collinge	1¾ inches Pneumatic (deflated)	1⅛	22.1	67	598	....	10.57

ENERGY EXPENDED IN PROPULSION.

The resistance, a vehicle offers to motion, may be divided into three principal elements, viz:

1. Kinetic resistance, or that which is common to all mass moved through any given medium.
2. Internal resistance, or that due to the construction of the vehicle itself.
3. Road resistance, or that external resistance due to the nature of the road the vehicle travels over.

The first can be calculated from known laws of kinetics; the second our experiments bear on; the third contains elements for further investigations than it has so far received. In this connection it was intended to have tests made of the resistance due to various road surfaces by measuring the energy input of the electric vehicles competing. The heavy fall of snow at the time of the Thanksgiving Day race interfered with these plans and an accurate profile of the course showing all grades, nature of paving and roadbed which had been prepared was rendered useless for such determinations at that time. It is to be hoped that further experiments will be made along this line to supplement what limited informatfon is now available and that future promotors of motocycle races will improve such opportunities for adding needed information in this and other directions.

PERSONAL.

Messrs. H. B. Camp and A. L. Daniels representing the H. B. Camp Company of Aultman, Ohio, have been visiting in Chicago for several days, doing missionary work in underground conduit. They don't think much of pump logs naturally, and they are impressing their views on engineers and purchasers. Mr. Daniels remains for some days longer to complete the work of proselyting.

Wire Commissioner John R. Murphy of Boston, has been appointed Water Commissioner of the city, being succeeded by Ex-Alderman Thomas W. Flood. These appointments became effective on February 1.

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A RURAL IDEA OF THE OSCILLATOR.

The following remarks, by the editor of the Winona, Minn., *Republican*, on the subject of Tesla's latest discovery, are comprehensive in their scope, if they are not of the greatest value to the electrical profession

"The developements of electricity have so mystified science, so revolutionized industry and so upset all preconceived ideas of the possible that one is prepared to accept even the wildest prognostications regarding what yet is to be accomplished through the aid of the mysterious fluid. One scarcely ceases to wonder over some new marvel in things electric before some newer and still more marvelous are presented, and so the human mind ever is looking for fresh discoveries, and it takes a big one to secure more than a moment's attention.

But Nicola Tesla, Edison's twin wizard in matters electrical, at last has struck the direct road to imperishable glory and honor. If the half that is claimed for his latest invention proves true, when rewards are passed around, his will not be a tin halo.

The apparatus, upon which Tesla stakes his application for the gratitude of mankind, is designed to cure all forms of organic diseases. His name for the device is the oscillator, and it is supposed to effect cures by a thorough shaking up of the human system, working through a series of electro-mechanical vibrations. The shaking up it gives is mild, yet thorough, and when it begins to get in its work, disease folds its tent like an Arab and silently steals away. Bacilli, streptococci, ascococci, diplococci, microbes, germs and all the rest of the deadly family turn tail and run like a dog involuntarily attached to an ex-tomato can. It matters not whether they are chromogenic, zymogenic, or pathogenic; whether they can withstand cold or heat, or are indifferent to all the drugs in the pharmacopoeia. When Tesla touches the button they recognize that it is time for them to take a rest, skip out, skedaddle, vamoose, run, fly or swim.

That is the kind of machine the Tesla oscillator is. In all around virtue and efficacy it knocks the spots off any patent medicine which takes less than a two-column space for its advertisement. The electro-mechanical vibrator has no wings at all, but it gets there just the same, and when it arrives it obstinately refuses to associate with anything except health. It is thoroughly up on the pedigrees of all the most fashionable as well as the most common diseases and it is more radical in its judgment of worthy ancestry than the Society of Colonial Dames. Even nervous prostration, that most aristocratic of afflictions, is set down by the oscillator in the same class with a vulgar stomach ache, and ennui is allowed no points of superiority over a torpid liver.

The principle upon which the oscillator is constructed was announced by Tesla several years ago. An Austrian scientist grasped it and in a crude way put it to practical use. Later he communicated with the electrician, declaring that he had tried it with wonderful success, even in cases of consumption. Tesla has not experimented with that disease, but from the observation of the Austrian he is confident that the much dreaded ailment is as powerless as are all other ills when brought into contact with the oscillator.

The thought which first occurred to Tesla was that most physicians prescribe exercise for the relief of many diseases. Coupling with this the value of electricity as a remedial agent, the inventor put his wits to work and evolved the oscillator. The machine does its work by a series of slight but effective electric shocks, which come at the rate of about 100 a second. In half a minute the patient derives as much benefit as he would derive from a day on horseback supplemented with a period of electrical treatment. At the same time the danger of over-exertion is avoided. It is reported, that the other day Ex-Mayor Abram S. Hewitt dropped into Tesla's laboratory in New York, and incidentally mentioned that his liver was a little off and refused to respond to persistent treatment. Tesla placed him on the oscillator, turned on the current, and in a minute or so had banished the ex-mayor's ill.

Such is the boon which Tesla is about to spring upon unsuspecting humanity. But he is modest in his claims, and therefore does not mention half the good things it will accomplish. One of these, we venture to imagine, might be a restoration of the entente cordiale between the able and courteous chairman of the Republican central committee of this state and the esteemed secretary to His Excellency Gov. Clough. Great are the possibilities of the oscillator. Permit us to hope that these gentlemen will avail themselves of its remarkable virtues.

NEW STYLE OF DUMB WAITER.

The lightning of the heavens has again been harnessed, this time to facilitate service in one of those record-breaking, sixty-miles-a-minute quick-lunch establishments peculiar to downtown New York.

This particular place of rapid transit mastication is on Beekman street, just off Park Row, and trim young women, with snowy aprons and fetching caps, stand behind long counters and hand out sandwiches, slabs of cake, sections of pie and hard-boiled eggs, and pour coffee, tea and milk for men who rush in wild-eyed, grab what they call for, rush for a chair, where they swallow it whole, and then go out on the streets and loaf for twenty minutes.

It differs from other places of its class in that the young women waiters do not punctuate the air with discordant cries of "two up," "one in the dark," "draw three," "pork and" and "on the griddle."

That is where the electricity comes in. The cold viands, such as sandwiches, eggs and pastry, and the beverages are ready at hand on the counter for the self-service of customers.

In addition to this, there are every day added to the bill a soup and five other hot dishes. At two points on the long counter, flush with its service, are set electric push-buttons, numbered from one to six inclusive. Immediately above the numbers, in ruled spaces, is written the special bill of fare of the day.

In the kitchen, on the wall, immediately over a glistening steam table, presided over during the rush hour by six attendants, one for each of the special dishes, is an annunciator, like those in use in hotels. There are two sets of the numbers, one to six, arranged one below the other, and pasted above the machine is the extra bill of fare for the day.

The device is simplicity itself. In rapid succession the tags marked one, four and six drop, and a bowl of soup, a chicken stew and a hot veal pie, respectively, are dished up, and the tags on the annunciator pushed back into position as the orders are filled. It is an interesting sight during the rush hour to see the six cooks silently, swiftly dishing up, while the annunciator continues to click and drop its tags with a monotonous metallic sound.

Outside two young women, pushing at the keyboard, silently receive the orders and touch the buttons. All the talking is done by the customers. The waiters on the main floor walk to the part where the keyboard is, give their orders and then walk to the kitchen delivery window, where the only words spoken are by the "disher up," who, as he passes an order out, will say "six."

"Six, right," replies the girl, as she bears the dish away.

Mr. Scripture, the designer of the device, does not claim any special merit for it. It is certainly not patentable. He believes, however, that it is capable of elaboration in both restaurants and hotels. The system could be made to answer for a bill of fare with a hundred items on it as easily as for six.

It certainly simplifies the problem of establishing the kitchen at a point remote from the dining room, far enough away to prevent the cooking odors from annoying the guests, and yet at the same time not retarding rapid service, a thing that Americans insist upon.—*New York World.*

Send in your subscription to THE ELECTRICAL JOURNAL.

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SURGERY OF NASAL SEPTUM.*

Electrolysis as a Treatment for Deviations, Spurs and Ridges Along the Nasal Canal—Direct Current Therapeutics.

TWENTY-ONE CASES REPORTED WITH RESULTS.

My lectures before the National School of Electricity have enabled me to estimate the lack of accurate information among physicians as to the nature of electrolysis as a remedial agent. This is my apology for giving a brief statement of the electrolytic process as an introduction to this paper. Electrolysis is that chemical change or molecular disintegration which occurs when a direct (galvanic) current of electricity is passed through animal tissue or any other electrolyte. If a direct current of electricity be passed through water (H^2O) there is an immediate disintegration of the liquid, oxygen being liberated at the anode (positive pole) and hydrogen at the cathode (negative pole). If this process be continued the entire amount of water in the vessel will be decomposed, and in its stead will be two parts of hydrogen by volume and one of oxygen. This is a simple illustration of the electrolytic action of electricity when applied to a simple electrolyte. If the substance to be decomposed or disintegrated is more complex in its chemical composition it will undergo the same molecular disintegration, but it will be more difficult of demonstration.

When a direct (galvanic) current is passed through animal tissue it is more or less disintegrated, its molecular, its cellular structure is broken up in the immediate vicinity of the poles. Near the anode (positive pole or electrode) oxygen, chlorine and acids are accumulated, while around the cathode (negative pole or electrode) hydrogen and alkalies are accumulated. There is, no doubt, some interpolar change in the tissues remote from the poles, but it is difficult of demonstration. An inflammatory action is excited, osteoclasts are left in the broken-down tissue and absorption takes place through their agency. Where a larger area is entirely cut off from blood supply it sloughs without absorption. The electrolytic power of the current is in proportion to its density, hence, it is usually applied by means of needles as the active electrode, the indifferent electrode being from a few to a hundred square inches in area, according to the quantity of current needed in the case under treatment. In bipolar electrolysis both poles, usually needles, are introduced into the tissue to be destroyed. It should be remembered that electrolysis does not necessarily mean the caustic destruction of tissue, but rather the chemical disintegration of it.

There is a primary and a secondary electrolytic action to be taken into account. By primary electrolysis is meant the chemical dissolution of the elements composing the tissue; by secondary electrolysis is meant those changes which occur owing to the presence of the liberated chemicals already referred to. The primary action takes place during the time the current is passing through the tissues, while the secondary action occurs so long as the newly liberated chemicals (hydrogen and alkalies, or oxygen and acids) remain free in the tissues and the osteoclastic absorption is in progress. In some cases it continues active several days. The characteristic reactions occurring at either the positive or negative pole is chiefly due to the peculiar chemic products formed at the respective poles. At he anode we should expect the tissues to be hardened, coagulated, owing to the presence of oxygen and acids about it. At the cathode we should expect the tissues to be softened, liquified, owing to the presence of alkalies there. A moment's consideration will suggest the wisdom of this law, for a vascular growth needs in addition to the disintegration of tissue to shut off the blood supply

No.	Name.	Age	Method.	Time Minutes.	No. M. A.	Spur, ridge, crest.	Effects—Remarks.
1	Mrs. T.	46	Monopolar.	18	18	Cart. spur on right side septum.	At the end of ten days the spur was disintegrated leaving a smooth surface covered with healthy membrane.
2	Mr. J. P.	28	"	20	18	Bony crest right side septum.	First treatment reduced crest some. Second treatment (one week later) 15 m.a. 15 min. reduced crest enough to overcome stenosis.
3	Mr. W. H.	24	"	25	18	Horiz. 1¼ in. bony. ridge right side sept	Fainted at end of ten minutes; placed him in reclining position and continued 18 m.a. for 15 min. without further inconvenience. One month later ridge gone and membrane intact.
4	Rev. L.	25	Bipolar.	12	15	Cart. ridge left side.	Two weeks later edges of ridge remaining were removed with a chisel. This required as much work and skill as an original operation with a chisel.
5	Rev. L.	25	"	3	15	Cart. spur left side.	Ten days later spur much reduced and membrane intact. Spur was quite small and of soft cartilage.
6	Miss G.	30	"	12	15	Cart. spur left side.	Large flat needle used at base of spur. At end of one week spur was much reduced and membrane intact.
7	Mr. J. R.	26	"	15	15	Cart. and bony ridge left side.	Eleven days later ridge gone but there was an offensive odorous discharge from seat of operation. Passed probe one and one half inches back between walls of septum. Twenty gr. argent. nit. checked necrotic process in three weeks.
8	Mr. L.	29	Monopolar.	13 27	27 20	Ant. cart. spur left Post rdg. bone.	A cathodal needle was inserted into each growth, a large sponge electrode being held in the hand of the patient. At end of thirteen minutes needle was removed from ant. spur, in twenty seven min. from post ridge. One mo. later ant. S. gone, post. R. reduced.
9	Miss E.	20	Bipolar.	20	20	Large spur left side. cart and bone.	After two weeks, spur gone and membrane intact.
10	Miss E.	20	"	12	15	Med. cart. spur right side.	After two weeks, spur gone and membrane intact.
11	Mr. E. S.	26	"	20	15	Cart. spur right side.	For fifteen days sloughing with foul odor; no perforation. At end of one month healing complete. Result good.
12	Mr. E. S.	26	"	13	13	Small cart. spur left side.	At end of two weeks spur was gone. No ill result.
13	Miss P.	21	"	16	14	Large cart. right side	At end of two weeks spur was gone. No ill result.
14	Mr. C. W.	18	"	18	15	Cartilaginous ridge on right side septum	Negative needle inserted one inch into ridge. Positive into crest of ridge. At end of first week ridge much reduced.
15	Mr. F. R.	50	"	20	15	Very large cart. spur right side.	At end of second week spur much reduced. Formerly there was great stenosis, now breathing channel was clear.
16	Mr. J. M. B.	25	"	20	15	Horiz. ridge, cart. and bone 1¼ in. long, left side.	Negative needle inserted one inch into ridge, positive inserted into crest. After three weeks ridge almost gone, stenosis greatly relieved.
17	Rev. S.	45	"	14	15	Horiz. cart. ridge on right side of septum	One month later ridge almost gone, membrane intact.
18	Mr. C. S.	32	"	15	10	Horiz. cart. rdg. (ant.) 1½ in. long left side.	Two negative needles used, one inserted into the anterior, the other into the posterior part of ridge. After three weeks anterior part gone, posterior reduced.
19	Mr. V. H.	24	"	16	15	Cart. spur on left side of septum.	At ent of second week spur gone and membrane intact.
20	Mr. E. S.	20	"	15	13	Cart. spur right side.	Spur only partially removed, a second operation with a chisel being necessary for its complete removal.
21	Miss P.	21	"	14	12	Small cart. spur on left side.	At end of second week spur gone, membrane intact.

*By William L. Ballenger, M. D., Clinical Instructor in Nose and Throat Diseases, College of Physicians and Surgeons; Member of the Chicago Academy of Medcine; Member of the Electro-Therapeutic Faculty of the National School of Electricity, Chicago.

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of the part, so as to prevent rapid repair of the part, while in fibrous tissue the blood supply is poor and a softening of the tissues is needed to favor absorption through the medium of the phagocytes and circulation. Hence vascular growths are most effectually treated with anodal electrolysis, while firm fibrous growths are best treated with cathodal electrolysis. In some conditions (notably bony and cartilaginous growths) it is indifferent which pole is used locally, or it may be found expedient to use both locally, in order that the current be confined more perfectly to the offending tissue.

The advantages of the bipolar method for operations in the nose are: *a*, the current is limited to the offending tissues and shock from diffusion of current to brain is avoided: *b*, perforation of the nasal septum is avoided as the current is limited to a field superior to the plane of septum, *i. e.*, to the path between needles in the growth; *c*, the method is simple and less painful than the monopolar method.

Specially devised needles may be used or in most cases extra large sewing needles answer every purpose. Moure[1] has designed a series of double needles to be used in the base of spurs and ridges; whereby he claims superior results are obtained as the current is more uniformly distributed through the growth, thereby favoring its complete removal with a minimum quantity of electric force. All my operations were done with single needles except No. 18. The part of the needle not imbedded in tissue should be insulated with varnish or small rubber tubing to prevent destructive action to inoffensive tissue.

The outfit needed to do electrolysis of bony and cartilaginous spurs and ridges of the nasal septum must embrace the following: *a*, a source of electric energy equal to twenty-five LeClanche cells—a properly reduced and guarded Edison current may be used; *b*, a reliable rheostat; the Massey current controller answering every purpose; *c*, a reliable milliamperemeter. It would be folly to attempt to do electrolytic work without accurate measurement of the electric energy employed. To depend on the number of "cells turned on" is as absurd as to tell a patient to take ten pills without regard to the quantity of medicament each represents. Cells used in medical batteries have an electromotive force ranging from 1 to 2 volts, and the resistance of the various tissues of the body varies all the way from 2,000 ohms to 500,000 ohms; hence there is no way of estimating the quantity of current passing through the body except to measure it with some reliable instrument. The quantity of electric energy required to disintegrate such growths as are of common occurrence in the nose and throat is from 2 to 30 m. a., according to the size of growth and kind of tissue composing it.

In my first paper [2] it is implied that I was the first American observer to write upon this subject, but I now freely accord Dr. James E. Newcomb, New York, precedence in the field. In the *Medical Record*, August 5, 1893, he wrote under the title, "Electrolysis for the Relief of Certain Morbid Conditions of the Nasal Septum." He gives an admirable review of the literature to that date with a report of two cases. Since then, there has been little that is new, except some slight modifications in needles and the adaptation of the Edison current to nasal electrolysis by Dr. Casselberry.[3] He takes the position, in an article read before the American Laryngological Association, at Rochester, that bony growths will not yield to the electrolytic action of the current, contrary to continental observers and also contrary to my own observation.

I present herewith a tabular report of twenty-one cases in private practice, from which I arrive at conclusions as to the propriety of resorting to electrolysis for the removal of septal spurs and ridges.

These cases were all well nourished, healthy people. An equal number of dispensary cases treated in the same way would, no doubt, show less favorable results. While the results are quite favorable in most cases, the fact still remains that as a method it is neither so simple nor so sure as others at our command. I quite agree with Dr. Bresgen[4] that its scope should be limited: *a*, to those cases in which it is impossible to carry out the usual surgical treatment, either on account of weakness or other disability; *b*, those cases in which more radical measures are refused; *c*, that electrolysis is not, nor can it ever be, a therapeutic measure which can be used by other than experienced specialists, because when carried out by unskilled hands it can only lead to disaster. Dr. Bresgen was supported in his conclusions by Drs. Hajek, Stoerk, Heymann and Chiari.

I will add the further conclusions: *d*, cartilage yields more readily than bone: *e*, an osteoma is more easily removed than normal bone, because, being an abnormal growth, it is an irritant and is therefore more unstable, requiring less irritation to cause proliferation of osteoclasts; *f*, only growths of minor size are successfully treated by electrolysis, those of major size being only partially removed; *g*, large growths, especially those with a wide base, should be attacked with double needles at base and single needle at apex; *h*, perforation and sloughing will result from the use of too much current, or from a prolonged use of a moderate one (see case No. 7); *i*, all cases should be thoroughly cocainized by placing a pledget of cotton saturated with a 10 per cent solution of hydrochl.cocain over the part to be operated on, and leaving it there for eight minutes.

1 Archives Cliniques de Bordeaux, February, 1893.
2 Journal on the American Medical Association, Nov. 10, 1894
3 American Larnygological Association, Rochester, 1895.

AMERICAN INSTITUTE TO BE INCORPORATED.

The council of the American Institute of Electrical Engineers announces in a card to its regular members that a meeting of the Institute will be held on February 20th next, at 8 o'clock p. m., to act upon a proposition to incorporate the Institute in pursuance of section 5 of the membership corporation law. The call is signed by Louis Duncan, James Hamblet, Wm. A. Anthony, Francis B. Crocker, Arthur E. Kennelly, Wm. B. Vansize, William J. Hammer, Chas. S. Bradley, Cary T. Hutchinson, Geo. A. Hamilton, William D. Weaver, majority of council.

AN IMPORTANT MEETING.

The French Association for the Advancement of Science will hold its next meeting at Tunis, Algiers, April 1-4, 1896.

The fifth section, Physics, will be presided over by Dr. J. Bergonie, Professor of the Medical Faculty at Bordeau and corresponding member of the Academy of Medicine.

In addition to papers and discussions on pure physics, questions of medical physics and more particularly electro-therapeutics will receive particular attention.

Mr. Andre Broca will present a report on "A Critical Study of Various Optical and Photographic Methods of Photometry from the Standpoint of Science and Industry."

WORLD'S FAIR MACHINES SOLD.

A great many people who saw and admired the wonderful electric lighting machines furnished by the Westinghouse Electric and Manufacturing Company to the Columbian Exposition Company for the purpose of illuminating the World's Fair were heard to remark at the time:

"What will be done with these machines when the Fair is over?"

It may be interesting for these people to learn that the Westinghouse company recently furnished four of them to the United Electric Light and Power Company of New York City, and they are furnishing current for lighting a considerable portion of the metropolis. Several others are installed in the plant of the Brush Electric Light Company at Baltimore, while the rest of them are distributed in several large electric light plants throughout the country.

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

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WILHELM EDUARD WEBER.

Born Oct. 22, 1804. Died June 23, 1891. In Association with Gauss was First to Make Extended Observations of the Earth's Magnetism. Published an Atlas on the Subject. Invented, also with Gauss, the Declination Needle and Bifilar Magnetometer.

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The Electrical Journal.

Vol. 1. CHICAGO, MARCH 1, 1896. No. 19

ELECTRIC ELEVATOR TYPES.*

A Detailed Description of Machines, Drum and Screw Winding, for Different Classes of Service. A Residence Elevator that Requires no Attendant.

METHODS OF CONTROL AND SAFETY APPLIANCES.

There has been so much written on the subject of electric elevators which is pertinent to the subject, that in presenting this paper I shall make free compilation from others, and supplementing these extracts with some new matter, I shall by lantern views illustrate some details of the more recent machines, their methods of manufacture, and some steps in their development.

The time has passed when any one can doubt that one of the most important applications of the electric transmission of power, and one, in the number and variety of its applications, already rivaling the electric railway work, which has made such marvelous strides in the past eight years, is that of the operation of all classes of hoisting machinery.

Some idea of the extent of the present elevator business may be gathered from the fact that in New York City alone there are not less than 5,000 elevators of various kinds, more, in fact, than there are street cars, and more people are carried vertically than there are horizontally.

Ignoring for the moment the specific methods of application, and discounting the difficulties naturally met in developing machines to do the duty required in modern office work, not alone the technical difficulties, but those commercial ones naturally met when a new company enters the lists with untried machines against the entrenched forces of existing industries, there was still much encouragement to be derived from a backward glance at the industrial changes wrought in the last few years, and to all objections raised there came the natural queries: Is the elevator field, great as it already is, limited to the possible application of a water or steam motor? Is there no wider, no more universal application of power for this class of service than has hitherto been presented? Is the hydraulic elevator the one bulwark to stand up against the assaults of the electric giant? Does it present such fixity of design, unity of purpose, refinement of processes, economy of operation and freedom from accidents as to preclude improvement if using some other power? from the street? It involves great initial expense, the conversion, distribution and reconversion of energy. It faced all the powers of conservatism, ridicule and fear. It had to combat the allied forces of the Bell telephone interests, tested by court action in over twenty States. It had the opposition of the strongest municipal and corporate influences. Every detail of the system had to be created, and yet it stands to-day unrivalled in its industrial progress.

Why is the same trolley system driving the cable to the wall, and why has its adoption marked the abandonment of a plant costing not less than $3,000,000, in the city of Philadelphia? Are there many more examples of the direct applications of force than the cable system, many closer connections between a great engine built for the highest economy and that which it moves?

Why is the steam locomotive giving way to the electric motor on suburban service? Is there any more direct example of the application of steam than is presented by a locomotive, the power of whose cylinders is transmitted directly to the drawbar through the intermediary only of a crank?

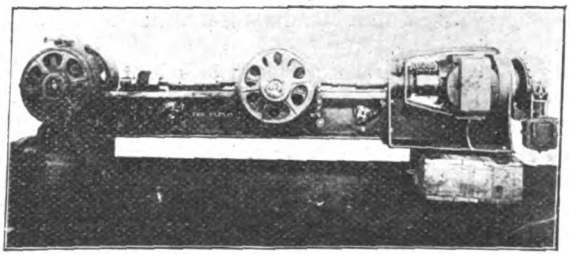

Fig. 2. SINGLE DECK MACHINE.

Why does the best shop practice dictate the abandonment of the slow speed, highly economical Corliss engine and the direct application of power by belts and shafting, and adopt the high speed engine and direct-connected dynamo at a central station, with the conversion, distribution and reconversion of energy by a dozen different motors at a greatly increased initial expense? Is it for any other reason than convenience, reliability and economy of operation?

Why has every overhead crane builder in the United States within the past four years absolutely abandoned wire rope, square shaft and hydraulic transmission for the three-motor transmission

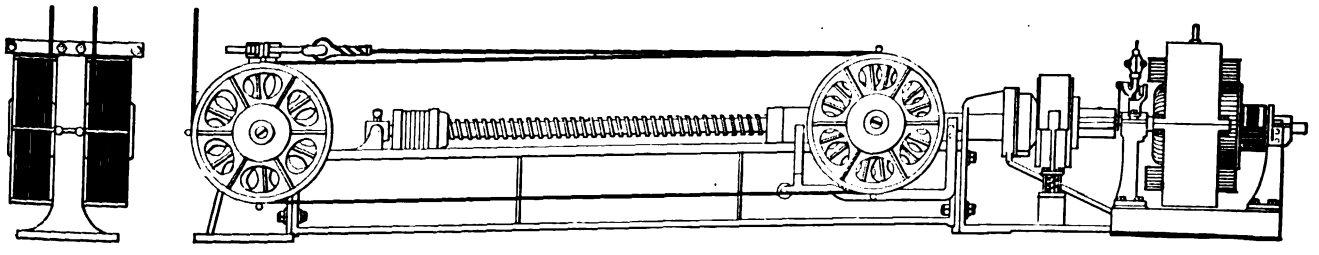

Fig. 1. SIDE ELEVATION.

Let us look at the record in other fields and ask: Why has the trolley system, born only eight years ago, driven the horse which I advocated only nine years ago? Is it because it is simpler, because it will cost less, or because it is economical, more flexible, and because it answers the purposes better than the other and more direct systems?

*Paper read by Mr. Frank J. Sprague, before the 102nd meeting of the A. I. E. E. January 22, 1896.

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Why have the great central stations of the country adopted electricity for the transmission of power to the hundreds of industries within the radius of their supply, and into what form of energy is the power of Niagara being converted?

In short, why is the transmission of power, in almost every case where flexibility, convenience, economy, efficiency and reliability are required, depending upon the electric method, not only in new work, but oftentimes in the replacing of older plants.

The elevator field, indeed, is a large one, and if the system is electric, then, considered from a commercial standpoint, there appear the following possible classes of work:

1st. High speed passenger service where no hydraulic plant is possible because of limited space.

2d. High speed passenger service in competition with hydraulic plants, the electric plant doing equal duty, costing less, occupying less space than the hydraulic, and costing much less to operate.

3d. Substitution of new high-speed electric service in place of old steam and slow hydraulic services in buildings where the limited space and interference with operations will not permit consideration of a new hydraulic plant.

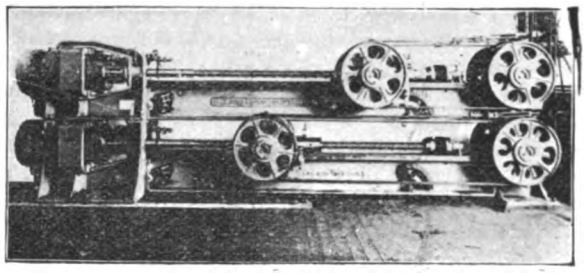

Fig. 3. DOUBLE DECK MACHINE.

4th. Passenger elevator service in buildings where the loads are comparatively light.

5th. Passenger service in private houses where safety, simplicity and noiselessness are essential.

6th. Freight and special classes of work.

For convenience we may classify elevator work as "first-class, that requiring speeds from 300′ to 600′ a minute," including the first three duties above mentioned, and as "second class," those requiring speeds of from 50′ to 250′ a minute," which include the remainder.

In general, there have been required and developed two kinds of machines to perform these services. The first is the outcome of the increased height of buildings and the demand for high speed and smooth motion, largely regardless of cost of apparatus, space occupied, or cost of operation.

The hydraulic elevator was the result of this demand, and was the only one, that up to a year or so ago, was accepted for this service.

It was to meet this demand—by creating an electric elevator which would do the work equally well, if not better, than the hydraulic—that the elevator to be more specifically described, was developed under some unexpected difficulties.

Of course, such a machine must have the speed and capacity of the hydraulic elevator.

It must be absolutely safe.

It should have advantages in the matter of space, and must be more economical to operate.

The second class of elevator work, that which requires lower speeds, is applied to small apartment houses and other buildings where a lighter elevator is required. This, for a long time, has been fairly supplied by worm gear elevators, and the replacing of the steam engine by an electric motor has enormously broadened the field for this class of machine.

These two machines, however, are not equivalents. They present two distinct kinds of rope movement, two absolutely different methods of control, and two varieties of safeties.

Just here I will briefly outline some of these differences, for they constitute in my mind vital essentials, and are absolutely determinate in their limitations.

The rope movement on the hydraulic is provided by an expanding set of sheaves by which all the ropes are maintained in fixed planes. Four to six ropes can be used on the machine, and six to eight on the car.

The sets of rope can be equalized at the machine, and they have a fixed lead in the hoistway.

The machines can be double and treble decked, and they have absolute limits of mechanical travel.

All of these features are of the greatest importance when dealing with high lifts, large powers and fast travel.

The drum machine, while having a distinct field of its own, and a most useful one, has not a single one of the characteristics mentioned. It cannot well use over two ropes on the drum, and they cannot be equalized at the machine. The lead is a shifting one, and on long lifts this may be as much as from four to five feet.

These particular objections have been met in a type of machine which may be called a cable drum machine, where the drive is by friction of the rope in the sheave grooves, but in both these machines, the plain drum and the cable drum, there is the very grave objection that there are no fixed limits of mechanical travel which are independent of the armature movement, and on fast speeds particularly, this is absolutely essential.

In the drum machines the driving power is applied through one or more worm gears.

In my own practice on light service, such as house automatic machines, and a low class of freight work, I use a single gear with double ball thrust bearings, and on heavier work, a right and left handed gear generally cut on the Hindley form, to give the fullest amount of gear surface, and with the shafts connected by independent machine-cut spur gearing, which allows the worm gears to be free from each other.

There is another distinction—that of control.

The hydraulic machine is necessarily a gravity machine, using power only in hoisting, its speed on the down side being controlled by the rate of water exit. The machine is, of course, under counter-weighted.

In the drum machine, when there is any attempt at economy, over counter-weighting is generally used, part from the car and part from the back of the drum, the over counter-weighting being approximately equal to the average load.

With these two types of apparatus as precedents, the problem was:

How far can electricity be applied? What are the limitations of control? What the conditions of installation and operation, and to what extent could one type be eliminated?

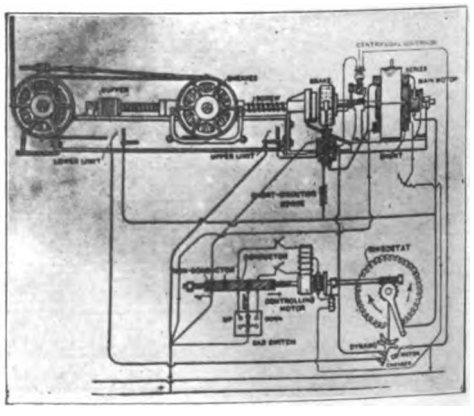

Fig. 4. WIRING PLAN.

And the answer is: Both types must be used, but for distinct classes of service.

Taking the drum type and considering electrical control on a machine over-balanced for average service, the load up or down

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is sometimes with and sometimes against the machine. To control such a machine directly from a supply circuit, (and I cannot seriously consider any other, no matter how ingenious or refined, as meeting general conditions), there is one method only, and that is the use of a rheostat in starting, and the inverse variation of the strength of the shunt field for about a two to one variation in speed. A cumulative series coil is only permissible in starting if variations of speeds are controllable, and, in any event, these variations are limited. Such a machine is, however, the best for second-class service.

Every one is familiar, of course, with the conditions of ordinary freight work. I might, however, here point out an important branch of this industry, and one which is destined for very wide application, and that is automatic house service, the machine to be controlled without an operator, and so installed as to be as safe as a stairway.

Briefly, such a machine, on my system of working, is equipped with an interlocking switch device on the machine, having a co-ordinating movement with it, and with the controlling circuit in series with a number of door switches automatically opened or closed with the doors. The doors themselves are fitted with mechanical locks, allowing a car to be opened only during a range of movement from 6″ above to 6″ below.

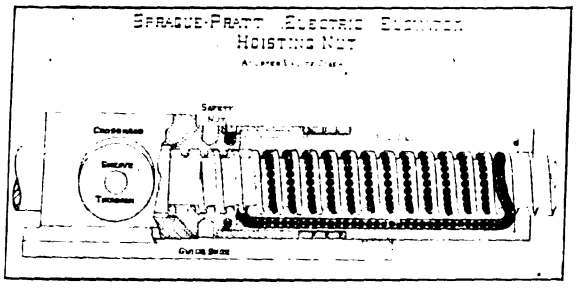

Fig. 5. FRICTIONLESS NUT.

At each floor is a single controlling button. If the machine is at rest, the pressing of a button calls the car, wherever it may be, to the particular floor at which it is wanted, where it automatically stops. When the door is opened it cannot be started, and when running, no one else can call it from the floor for which it is destined. The machine also has an additional control in the car, and the safeguards attending its operation are such as to make it safe for servant, nurse, child or invalid.

The development of the multiple screw elevator was undertaken for the express purpose of supplanting in a large way the former standard for high duty office service, and although not by any means an easy problem, either electrically or mechanically, a knowledge of what the hydraulic elevator is, and the variation of the types existing, gave adequate reasons for its attempt.

Let us consider for a moment a hydraulic system, and institute a few comparisons.

It consists primarily of a steam cylinder, or a multiplicity of steam cylinders, working ordinarily under poor conditions of steam economy, that is with a fixed cut-off in the high pressure cylinder of a compound pump or no cut-off in any cylinder of a simple pump. This element corresponds to the cylinders of a steam engine in the electric system, which use steam expansively with a cut-off varying according to the load, and under pressure conditions which are somewhat better than exist in a pump. It is to duplicate the results of this system of variable cut-offs and steam expansions that the energies of the various pump builders have been more or less ineffectually bent for a great many years in plain acknowledgement of that defect in their simple and duplex pumps, the latter of which are common to almost every hydraulic plant of any size in the United States.

It is true that a so-called "high duty" pump with equalizing piston is used on some of the larger elevator plants, but its use has not proven by any means entirely successful, because of the spasmodic nature of the service.

Among the high-duty pumps, the use of the flywheel type such as is used on large water pumping stations has been attempted, but rarely, I may fairly say, with success.

The next element is the water cylinder, which corresponds to the dynamo in the electric system, and on account of the high friction due to the packing, the efficiency of a water cylinder with its valves is not ordinarily equal to that of a dynamo, which with a motor, stands to-day the typical example of an efficient energy converter.

The next element is the piping and the tanks, compression or roof, and perhaps an accumulator, into or through which the water is pumped for delivery to the controlling valves of the elevator, and that which corresponds to this in the electric system is its simple wiring, and if a storage battery is used, then this last in conjunction with it.

Any competent engineer knows that, measured by standard practice, a given number of pounds of energy can be delivered to the controlling apparatus of an electric elevator for less pounds of steam, that is, water evaporated, through the medium of no less than fifty combinations of engines and dynamos, than can be delivered to the valves of any hydraulic cylinder through the standard pumps permissible in average elevator service. To be specific, the average water evaporation on a compound duplex pump, which is almost universally used, will in practice, be not less than about 60 to 70 pounds, per horse-power, of water energy delivered to the controlling valves, whereas the electrical combination will easily give the same for less than 40 pounds.

There are exceptional conditions in which a higher economy can be gotten in a hydraulic system, but they are few and are not typical, and under equal conditions the steam consumption in an electric system can be cut in two.

But this is not all. The fact is persistently ignored, although the attempt is made to offset it by recent experiments with a differential piston, that a standard hydraulic elevator uses the same amount of water under the same pressure for every foot of travel of a car, which volume of water and pressure are determined by the maximum load which has to be carried, although the average load on the ropes, including the excess of car over counter-weight, is not over one-third of the maximum. On the other hand, the electric elevator uses, and must use, under normal conditions, current directly proportional to the work, modified in a small degree by starting and slow running.

In short, over and above the friction load of the generating system, the steam consumption in the engines and the generation of electricity in the dynamo vary with the demand of the elevator machines. It is a system which is of necessity automatic.

On the other hand, the hydraulic system is one of the most flagrant violators of the relation which should exist between demand and supply. It is a system of transmission by water, having at one end a generating plant doing full duty for every foot of travel of its piston, with a variable duty on an elevator car at the other end, and an intermediate straight line water engine with its pipes and tanks taking care of that variable duty and using the balance of its energy in heating the water which passes through its valves.

Lack of economy, however, is not the only objection to the hydraulic system when looked at from the architect's or builder's standpoint. Until recent developments, these have always been strictly handicapped, not so much perhaps in the matter of cost, but in the internal arrangements of the building as well in the lay-out of the basemant, neither of which could be finally and satisfactorily, if even then, determined, until the particular type of machine had been accepted by the owner, and the contract finally made for it.

Nor has there been either singleness of design or unity of plan of operation. Each maker has had his own form of construction, his special method of control. Every building has brought up a problem more or less new, or at least conditions which had to be seriously considered in determining the elevator service. Horizontal and vertical machines, in basement or shaft; high or low multiplications; long and short, single and jointed cylinders;

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big and little diameters; large and small sheaves; free and suspended counter-weights; pulling and pushing machines; direct and differential pistons; roof tanks, stand pipes, accumulators and compression tanks; high and low pressures; hand rope, wheel or pilot-valve control; simple or compound pumps—all have made a nightmare of complications, giving more initial and continuing source of complaint and dispute than all the other engineering problems in a building.

So what more natural than that they should turn to electricity for emancipation? And this tendency is augmented by other reasons.

Leaving out central station supply, always, when properly equipped, to be preferred when the electric service is of a spasmodic or limited character, and considering for the present those large plants which characterize the modern office or hotel building and in a way rival central stations, every engineer knows that the fewer the number of well-proportioned units, the more alike they are, the freer the interchangeability between themselves, and the greater the extent to which any one unit can be utilized, the better the system for power generation and conversion, no matter what its character.

The best modern practice makes a three unit direct-connected engine and dynamo plant the best for lighting a building. There is an empirical relation existing between the number of lights required in a building as ordinarily designed, and the elevator service. When, in addition to the lighting service, such a building adopts electric elevators, it is not now necessary that it shall add an independent generating plant.

All that is required is that the three units should be somewhat increased in size and, perhaps, one of them preferably divided, the mains all taken to a common switchboard with two-way switches, and every engine and dynamo thus made interchangeable on either the lighting or elevator circuits, and at times both, especially if using a slow acting corrective converter, some of each can be run from the same engine and dynamo. So, instead of five or six units, some water and some electric, the entire generating plant is reduced to a single system consisting of three units of one size, or two of that size and two of a half size, which can be run interchangeably, and one of which is almost always in reserve.

Just here it is well to consider the probable application of the storage battery which, if built with plenty of lead, with large surfaces and for heavy momentary discharges rather than for long time steady discharges, will prove a most important adjunct to elevator service, which, like railway work, is spasmodic in character.

A modern office electric elevator on actual average service requires an expenditure of about one kilowatt hour per car mile of travel for every eight or ten feet of platform area. A car will make from 1½ to 2½ miles per hour, so that a battery of six elevators will run from 9 to 15 miles, although very rarely making over 12 miles per hour. With an ordinary car, say from 30′ to 35′ area, this would mean from 3 to 3½ kilowatt hours per car mile of travel, or say 35 to 40 kilowatt hours for a battery of six machines. Without a battery this would require a 120 kilowatt machine as ordinarily rated, worked at an average of 35 to 40 per cent. load. With a properly constructed battery a 60 or even a 50 kilowatt machine will handle the elevators.

Roughly speaking, a storage battery should be able to stand twice the dynamo rate for from three, to seven or eight seconds, and the dynamo rate for one-half a minute. If it has an hour discharge capacity equal to the dynamo capacity in kilowatt hours, it should be perfectly capable to run the Saturday, Sunday and night service required in an elevator plant without losing more than one-half its charge.

So much for the general conclusions on electric elevators, which are necessarily more or less brief.

To meet the hydraulic machine there was designed and developed what is now known as the Sprague-Pratt multiple sheave electric screw elevator, following the general lines of a tension hydraulic machine in the matter of rope movement, limit safeties and method of control.

The net result has been, that this machine now stands the superior of the hydraulic elevator in that it has its speed and capacity with, if anything, greater safety, and certain advantages in its automatics.

On high lifts it occupies less space; it is more flexible in its application, is more economical to operate, and it is more easily cared for.

General Description,—The machine may be described as the combination of two old elements with one new one, with specific safeties and methods of control.

Briefly, it is of the horizontal multiple sheave type, with a traveling cross head and frictionless nut driven by a screw revolved by a motor directly connected, and governed by a pilot motor and rheostat.

The general construction consists of a heavy main beam, carrying the traveling crosshead and the lower screw bearing, with special castings bolted at each end, one carrying the fixed set of sheaves, and the other the thrust bearing, brake and motor. The regulating apparatus is independent and self-contained, and is placed on the wall. From the car to the system of multiplying sheaves the direct multiplying machine and the horizontal hydraulic elevator are practically the same. The crosshead, however, marks the point of departure in the two types.

In the hydraulic machine, this crosshead is rigidly attached to the end of a rod which terminates in a piston moving in a cylinder having an inside length equal to the lineal movement of the

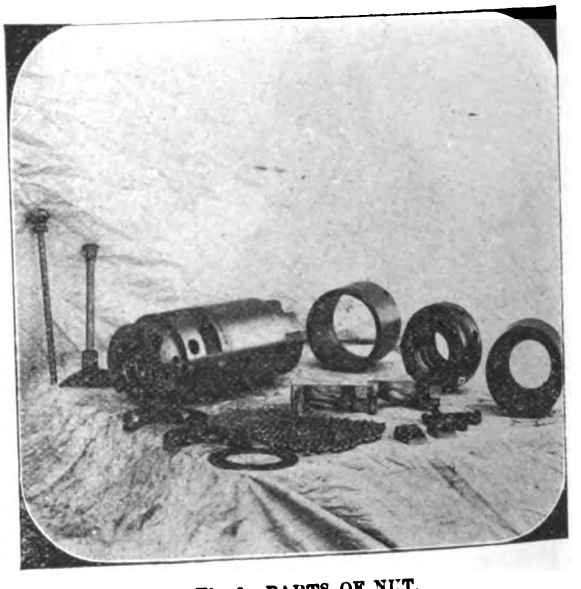

Fig. 6. PARTS OF NUT.

crosshead. This cylinder in the vertical type of hydraulics varies from 30 to 50 feet in length, with from 2 to 12 sheave multiplications, and in the horizontal types the multiplication runs as high as 14, with corresponding diminution of length of cylinder and increase in cross-section. Whatever the gearing, however, the length of cylinder is a function of the car travel. In this electric elevator, the crosshead being moved along a screw, stationary so far as the lineal movement is concerned, there is, with any given number of sheaves—only one variable—the length of screw; and, for all heights above about 100 feet, the electric machine has an advantage in matter of length, which, with increased rises becomes of great importance.

Looking to the needs of office buildings, there have been adopted two methods of rope multiplication, determined by the height of building, and so selected that the length of machine over all, shall not exceed about 30 feet for rises approaching 300 feet actual car travel. From this the length grades down to about 21 feet, so that all rises between 60 and 300 feet can be taken care of with an extreme variation of nine or ten feet in the length of machine, and there are thus provided limiting dimension data of great convenience and utility.

These systems of multiplication I may term direct and indirect. In the former, the entire multiplication, varying from six

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to ten, is done at the machine, and the ropes lead from the end sheaves over the shaft sheaves direct to the car. A free counter-weight is used, the ropes being fastened to the car frame. In this method, which is that common to all horizontal and to many vertical hydraulic machines, the hoisting and counter-weight ropes have unequal duty; furthermore, the ropes having the maximum bending, travel on the outboard sheaves at the same speed as the car. This last is the case also with all vertical hydraulics. In some of the latter, the counter-weight is carried in the cylinder on the piston, or in the strap, or both, its weight being as many times that of a free counter-weight as there are mutltiplications. Sometimes both methods are used.

Economy of operation and smoothness of movement, however, are antagonistic in their relations to the amount of counter-weight carried. The best method is probably that used when there is a single multiplication in the shaft, giving a two to one counter-weight traveling at half speed, and carried by all the car-hoisting ropes, as is done for short-rise vertical hydraulic elevators.

For long rises I have adopted a combination vertical and horizontal machine rope practice, giving even a more compact machine, a longer life of ropes, and better counter-weight results.

In this indirect system there is a division of multiplication, which, while having the same effect so far as speed of car and length of machine are concerned as a high direct multiplication, has an entirely different result in the wear on the ropes and the amount of counter-weight which can be carried without jumping.

This is accomplished by making one-half the multiplication (6 or 8) on the machine, the ropes, properly proportioned, going thence to the bottom of the counter-weight frame, which has a single multiplying sheave on top. The car ropes go over the shaft sheaves, under the counter-weight multiplier, and back up the hoistway, where they are anchored, giving a car speed twice that of the counter-weight. The equalizing chains, used to make the pull of the car with any given load constant at all points of the hoistway, are fastened to the bottom of the counter-weight frame and anchored in the hoistway.

The space occupied by this multiplier is only two or three inches more than by ordinary form of counter-weight. A proportionally shorter screw, fewer revolutions, and sheaves of greater diameter, characterize this type of multiplying machine.

This system seems to be the best yet devised for long rises, for not only do all the car ropes do equal duty, both with relation to the hoisting strain and the counter-weight, but the rope wear must be less because of the division of speed and multiplication, the necessity of changing only one-half of the ropes at a time, and the possibility or reversal of the ropes on the multiplying machine to get a new wear.

Where space is limited, I use a double decked machine, and in the new Commercial Cable Building, which is to be 21 stories high, the machines will be treble decked, and about 10½ feet in height.

Details.—Turning now to the detail construction and operation of this machine, there are a number of features claiming special attention, each unique in character, and marking a radical departure from all other elevator practice. These are the nut, screw, and thrust bearing, the brake, the motor, and the regulator apparatus.

One of the most interesting as well as important features, and, perhaps, the one which has been most frequently attacked, is the nut system. It joins the crosshead of the traveling sheaves by a conical seat. There is no fastening between the nut and the crosshead, the continual weight of the car always keeping them in contact; and the friction at this point, being greater than between the nut and the screw, enables the latter to transmit a stright-line movement to the crosshead when the screw is revolved by the motor, and also to revolve the screw and drive the motor as a dynamo when the mechanical brake releases the screw to allow the car to descend. These are the normal functions of hoisting and lowering. There are several other distinct functions of this nut which will be described in considering the "safeties."

Continuing the line of transmission of power, the only points of contact between the interlocking nut and screw are by a chain of balls which occupy a number of threads, and enter and leave the ends of the nut through tubes which are connected together so as to make a continuous conduit. This is one of the most vital points of the elevator apparatus, and herein lies one of the most potent reasons of its success—the reduction of friction by rolling instead of sliding surfaces on almost all parts under pressure; for not only is the nut so constituted, being in fact a developed spiral thrust-bearing, but the thrust-bearing at the motor end of the screw is taken on balls and the sheaves are carried on ball or roller bearings.

This nut being a vital part, its development has been most thorough, and a peculiar treatment of steel which has been adopted renders its surface so hard that the wear is very small, and it is well within commercial limits.

So free is the machine from static friction that it is possible to start the car with a very slight increase of current over the normal hoisting current, providing time be taken so that the work done in acceleration is small to the work of lifting, although that is not the usual practice.

The balls have an average crushing strain of 25,000 pounds each, but the working pressure varies from only 50 to 125 pounds per ball.

The nut system is a compound one, for, besides the working-ball nut there is another, called the "safety-nut," to which I will make reference later, keyed to it, and between the two is a powerful spring under compression.

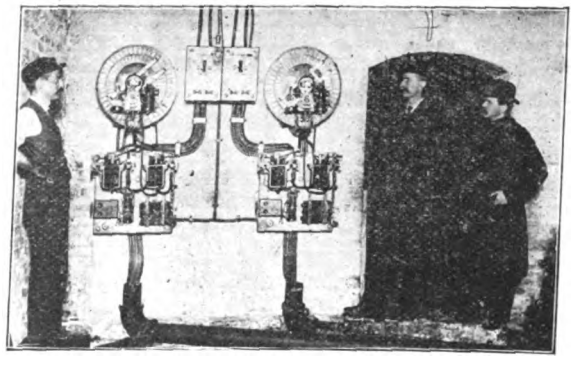

Fig. 7. MOTOR CONTROLLER, CHICAGO BOARD OF TRADE.

The screw is a forged bar of high carbon steel with a peculiarly shaped thread, the finished screw having a tensile strength of 700,000 pounds. It passes through the clearance hole in the steel trunnion crosshead, which carries the traveling sheaves, then through the nut, and is carried at the outer end by a fixed bearing.

This screw is sectioned, being joined to the armature shaft by a cone-seated coupling, secured by a taper gib.

The in-board end of the armature shaft, which is in effect, the extension of the screw, terminates in the thrust-bearing, where the pressure is taken by about 200 steel balls carried in a bronze guide plate and bearing, by specially hardened steel disks. The thrust of the screw being thus taken up on the in-board end, the strain on the screw is invariably between that end and the traveling crosshead—never beyond this; hence it is always under extension strain—never under compression, and cannot buckle.

The action of the balls on the screw, which is untreated, is peculiar. They form a path for themselves partly by wear, but principally by rolling compression of the steel, which finally becomes exceedingly hard, such that the edge of any ordinary machine tool would be turned.

The balls themselves wear very evenly. Oblique forms in normal practice cannot exist.

Beyond the thrust-plates is keyed an iron pulley, connected by a flexible coupling with the motor shaft. The function of the brake is that of locking the screw when at rest, it is not a means of varying the speed. In case of accident it has the additional

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function of helping to stop the screw. It may be described as a compound electro-mechanical brake. A steel brake band, wood-lined, is anchored at one end, the hoisting-side on the motor-bed frame, and the other end is continually pulled down by a powerful spring under compression. The mechanical movement in opposition is through the medium of a peculiar magnet. It is operated by a dual circuit, one in hoisting, another in lowering. In the event of failure of current for any reason, or too high a speed on the down run, this magnet releases the brake in the latter case by a snap switch, operated by an adjustable Pickering centrifugal governor driven by the main screw—and the brake band promptly grips the brake wheel softly yet powerfully.

Motor.—The motor, which is of the multipolar type, is carried on the same casting which contains the thrust bearing. The field magnets are of steel, and are excited by two circuits; one, known as the shunt circuit, being variable in strength at will, so as to vary the maximum speed of the machine, and the other, a series circuit, which acts to strongly compound the field. This type of elevators is differentiated from all other electrics by the fact that the action is like that of the hydraulic, for it always works against gravity. In hoisting, the motor takes current from the line, but in lowering, its main circuit is cut off from the line, and the motor, rotating in an opposite direction, is driven as a dynamo by the weight of the car. A strong element of safety existed in the fact that the current in the field coils is never reversed, and consequently the machine is never demagnetized. Hence, under certain conditions of the operation of the safeties, it has a power of self excitation which is of importance.

The armature which turns in this field is of the ironclad type, and not liable to injury of any kind.

It is mounted on a sleeve, is of the 2-path series winding, has a very large commutator, and, of course, multiple carbon brushes. The field coils can be removed without disturbing any other part.

Control.—Considered in its simplest, and in connection with its action upon the motor and multiplying machine, without reference to the means of communication between the car and the regulator, this last is a very simple device. Is is composed of two parts, each made up of peculiarly shaped iron grids of various sizes arranged in circular form, connected to copper contacts on a slate disk over which passes a heavy carbon brush.

The use of iron castings of a specific composition possesses great advantage over any form of wire resistance, not alone in the matter of cost. They are flexible, they expand in any direction readily, and, as made, they have a resistance of from forty to fifty times that of copper, or roughly, that of German silver. The grids are interchangeable, and any of them can be readily replaced.

One side of the rheostat is for regulation in hoisting, the other for lowering. Instead of moving this regulator by hand, it is operated by a pilot motor wound with a right and left-handed field, one or the other of which only at a time, can be in circuit with the armature. This pilot is connected to the rheostat arm by a single reduction worm gear, and is operated either from the basement or the car, according to the position of the "change over" switch, by an "up" and "down" button with an automatic lever stop which normally has to be held by the operator to prevent the pilot returning to a stop position. The spindle of the rheostat arm operates switches co-ordinating in their movement, in turn controlling the magnetic make-and-break circuit switches, the down brake, and also the automatic stop lever switches which limit the pilot movement.

The use of magnetic switches instead of hand control switches not only removes the arcing from the face of the rheostat, but it gives the benefit of instantaneous cut-offs not possible by any other means of control.

This, on fast machines is of the utmost importance, and the practical application is, that if the car is on the "up" motion, and an operator, because of carelessness or because of fright lets go his stop handle, the current is instantly cut off, the regulator following to stop, and the car is arrested in the shortest time practicable.

Assuming that the circuit is made for the up movement, it first meets with a resistance sufficient to about hold the car and lift the brake. The resistance is then gradually cut out, the torsional effort of the armature is increased, giving the car an upward movement with an acceleration depending upon the rate of movement of the rheostat arm, and with a final velocity determined by the point at which the arm is stopped.

If, while hoisting, for any reason the current is cut off, the torsional effort ceases, the brake instantly comes into action and the car comes to rest.

In lowering, the brake is lifted by an independent circuit, but the armature is first short-circuited on itself, and becomes a most powerful dynamic brake. As the resistance in this circuit is increased, the car runs faster. When it approaches the lower limit of movement, an independent retarding circuit is established, and gradually reduces the resistance. This brings the car to the slowest movement.

The pilot movement regulation is, to my mind, an absolute necessity of fast passenger work; and its application, although at first attended with a number of annoying difficulties, is to-day by far the most reliable method of control known.

Safeties.—Of course, the vital question to be considered in any elevator system is that of safety. In that respect, I think, we are amply provided. Safeties may be considered under two heads:

First, those on the car, and second, those on the hoisting machine.

On the car we use a special centrifugal which is attached to the lower section of the car frame.

It consists of two long levers, short-fulcrumed at the sides of the car and operating clamping jaws which run in close proximity to the car rails, but normally out of contact with them. The inner ends of the levers overlap, and in action are pressed apart by a very powerful spring under compression. When out of action, these levers are drawn together, the spring is put under compression, and the system locked by a trigger. Near the trigger is a centrifugal governor, operated by a standing rope, which at a determined speed releases the trigger, frees the levers, and the safeties clamp the rails with a pressure of about 16 tons. This safety can be released from the inside of the car.

In the car, as has already been described, there is an automatic stop contact which operates to bring the regulator to the stop position and the car to rest in case the conductor removes his hand from the controller because of crowding, accident or carelessness.

On the hoisting machine there are a number of safeties. One which is perfectly apparent is due to the fact that the crosshead is moved by a screw with a heavy armature on the end of it, which is driven through the medium of a nut by a car of limited driving capacity. The screw itself is of forged steel, under tension and torsion strains, with a safety factor of at least twenty to one.

The hoisting nut, as already described, is hardened by a specific process which makes its wear very limited. In addition to this, there is in the nut system what is called a "safety nut." Normally this is out of contact with the thread of the screw, but it is secured to the hoisting nut, and should any accident happen to the latter, breaking its hold on the screw, this safety nut, the threads of which interlock with the screw's threads to a greater depth than the thread of the hoisting nut, would then take the place of the hoisting nut and securely grip the screw. This would put the elevator out of operation because the friction between the nut and screw would be greater than the friction of the traveling crosshead, and it would act simply as a collar on the screw.

The nut system has in addition another function. Since the hoisting nut is only held from revolving by its friction against the crosshead, when the nut gets to the upper limit of its travel the safety nut meets a solid collar on the screw which stops its travel, causing it and the ball-bearing nut to revolve with the screw, without, however, necessarily stopping the motor, and

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leaving the traveling sheaves to be stopped simply by the weight of the car.

There is still another function performed by the nut system, that of a slack cable device. If for any reason the car in descending, when of course the nut is driven along by the screw, meets by an obstruction, the pressure of the nut being instantly reduced, it recedes slightly, allowing the springs between it and the safety nut to expand, throwing the latter into back contact with the screw threads. The nut system then instantly grips the screw, revolves as a collar, and consequently acts as a check against any marked movement of the crosshead corresponding to a free fall of the car on the ropes.

Assuming, however, the condition of a perfectly free release from all operative safeties, there is a limit to the rate of revolution of the screw, and in any event there is a rubber buffer at its lower end which would cushion its stop so as to prevent any injury.

Besides the lower limit switch, which has already been mentioned, which puts an increasing retarding force on the motor, there is an upper limit switch for cutting off the current; this is a self-cleaning lock switch, operating in both directions, and moved by a roll on the croshead. It cuts off the current in hoisting in the upper limit, and allows the brake to come on. On the reverse movement it is automatically closed.

I have already mentioned the governor on the machine, which is called a "monitor centrifugal." This is for operating the brake when running too fast. In hydraulic elevators there is no speed-operated device in case of fast running except the centrifugal on the car and this is frequently set so much above the normal speed on account of the annoyance of having it operated by a temporary excess, as oftentimes to be useless when actually required. The monitor centrifugal does not throw the machine out of operation, but simply slows it up to any desired speed, and then allows the operator to resume control.

The dynamic action of the machine is made use of in still another way by the introduction of an "automatic choking circuit" and switch operated by the same circuits governing the main brake. It is in constant play and closes the circuit around the armature and its series coils through a rheostat under any of the following circumstances: At each stop from up or down; when running fast enough to work centrifugal on the machine; on failure of the hoisting current, or on failure of the line current.

So positive is the control over the motor, no matter whether it be operating to hoist the car or retard it in going down, that the brake band can actually be removed and the car still controlled, and even with the brake in normal position the change from one position to another can be made so promptly that it will remain inactive.

Such is the machine which has been developed during the past three years, and whose first applicatiou in a large battery in the Postal Telegraph Building seems destined to have the same effect on the elevator industry that the plant at Richmond has had on the railway industry. It is only permitted to me, of course, to make the briefest allusion to this, but as illustrating in some degree the extent of this industry, buildings of from five to twenty-one stories in height are being equipped with batteries of from one to twenty-six machines of varions types, and the business of a single company employing some two or three years ago a handful of men, now demands a constantly increasing force already numbering nearly five hundred.

DEATH OF MRS. A. B. KIMBALL.

It is with much regret that we must announce the death, after a short illness, of Mrs. A. B. Kimball, wife of Prof. A. B. Kimball, of the Worcester (Mass.) High School and instructor in that city for the National School of Electricity. Prof. Kimball has the sincerest sympathy of all his friends.

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

BOOK REVIEWS.

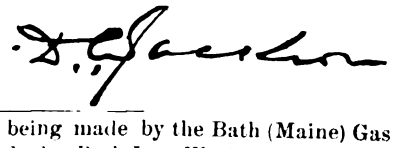
THE MECHANICAL ENGINEERS' POCKET BOOK, by William Kent, A. M. M. E.: John Wiley & Sons, New York.

Among the numerous engineering books which were published during 1895, the one which will be of most general value to engineers connected with industrial interests is probably Kent's Mechanical Engineers 'Pocket Book. Its author evidently was well qualified by talent and experience to compile an engineering pocket book, and the result of his labor is a book which, for industrial engineers, at least, is well in advance of any of those now existing. The books of Molesworth, Haswell, and Nystrom have held enviable places, but Kent's book is a distinct advance upon each of them. In the thousand or more closely printed pages dealing with general or mechanical engineering there seems to be little or nothing which is either superfluous or criticisable.

While the book deals, to only a small extent, with matters purely electrical, the main body of the matter contained in it is of nearly as great value to electrical engineers as to their mechanical brethren. It is unfortunate that the few pages (·7) which relate distinctively to electrical matters do not contain a better selection. It is quite startling to find the economical dimensions of electrical conductors referred to tables and formulas published in 1885 and 1886, which, on account of the small knowledge of the subject at that day, in no wise covers the conditions met in modern electrical plants. Many other questionable statements are to be found in these few pages, but I will give only three additional examples. The names of magnetic units recommended by the American Institute of Electrical Engineers are presented as though they were in common use or had been authoritatively adopted, which is not at all the case; the formulas for the magnetic circuit of the dynamos are given in Kapp's earliest approximate forms which have since been abandoned by their author in favor of accurate and more rational forms. (It is but fair to say that the example of magnetic calculations is given in Thompson's more rational method.) Exhaustive tables of the heating in the windings of electro-magnets are given without a full statement of any experimental foundation upon which they are based, which is in fact rather insufficient.

It cannot be expected that one book shall contain everything, but it is to be regretted that one of so much usefulness should be marred by the insertion of doubtful matter relating to a branch of the engineering profession with which the author can scarcely be expected to have an intimate acquaintance. There is a reward awaiting the man who has the necessary ability and experience and who will compile an electrical engineer's book which is as satisfactory as Kent's Mechanical Engineers book. A Pocket Book of Electrical Engineering Formula, by Geifel & Kilgour makes a good start, but it only half fills the requirements since it contains virtually none of that data based upon engineering precedent and experience upon which electric railway, electric transmission of forces, and electric light men and electrical designers must largely depend. Hospitalier's Formulaire Pratique de l'Electricien fills the bill a little better but has the disadvantage of being printed in a foreign language.

The mechanical execution of Kent's Pocket Book is reasonably good, in fact it is all that could be desired.



Negotiations are now being made by the Bath (Maine) Gas and Eleciric Company and the Bath Iron Works, for utilizing electricity instead of steam in the latter place. The company have already placed three motors in position at the Works and they give the highest satisfaction. The Works will require about sixteen motors varying from three to forty horsepower. Among the objects of making this change is the saving of labor and power, as well as expense. The work of making the change will take from sixty to ninety days.

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HERE, THERE AND EVERYWHERE.

Light and Power.

According to a Reuter dispatch from Christiania, the estate of Hafsluhd, near the great waterfall known as the Sarpsfos, between Christiania and Göteborg, has been acquired by a syndicate, chiefly consisting of German and American capitalists, for the sum of 800,000 kroner. The purchasers intend to form a large company, with a capital of 3,0''0,000 to 5,000,'00 kroner, in order to utilize the water power of the falls for electrical force, and establishing aluminum works on the same principle as those now being constructed at the falls of Foyers, in Scotland. The Sarpsfos is one of the finest falls in Southeastern Norway, being 74 feet in height and 116 feet in width. The water power is already utilized, however, by numerous sawmills and celulose factories, and the railway crosses the fall, so that the proposed new works will probably not interfere to any great extent with the artistic aspect of the place.

Information has been received from Duluth, Minnesota, that the Altmonte, Minnesota, and St. Louis River Water Power Companies have combined, or at least the two former have combined, and will absorb the latter. The object of the companies has been, and will be, to build a storage reservoir and convey water to Duluth by canal and immense pipes and also to generate electricity at the falls of the St. Louis River. The plan of the Minnesota Company provides for an expenditure of $10,000,000, and it is said the deal between the three companies has progressed so far that $150,000 of earnest money has been advanced as a guarantee of good faith.

The eight-year franchise of the Mexico Gas & Electric Light Company, of the city of Mexico, Mex., expires on May 8th next, when the corporation, under the terms of the contract, is entitled to buy the plant. The city government has requested S. B. Knight, manager, to render an estimate of the value of the plant by February 1st, which seems to lend probability to the belief that public lighting will become a regular muuicipal service.

The *Elektrotectinischer Anzeizer* is authority for the statement that the city of Guatemala, the capital of the republic of that name, in Central America, is to be furnished with electricity for power and lighting from a station placed at a water fall twenty-two miles distant. The three-phase system is to be used with a potential over the line of 10,000 volts with transformers at each end.

An important addition to the Carnegie Company's manufacturing interests at Duquesne, Pennsylvania, is an electrical plant, which is being built in connection with the blast furnaces in that town. The works are to furnish light for the furnaces, and motive power for machinery. The plant will be the largest in the vicinity, and one of the finest in the world.

The Lowell Electric Light and Power Company, of Lowell, Michigan, has run a line of wires to Grand Rapids, a distance of twenty miles, and will furnish cheap electric lights. The Lowell plant is operated by water power.

The village of Lupcourt, in France, with a total population of 250 souls, has just completed a municipal lighting plant. A two horse power turbine and a direct current, 110 volt dynamo have been installed.

The coming Swiss National exhibition will be supplied with 12,000 electrical horse-power from the River Rhone. The plant will be installed at a point six miles distant from the exhibition buildings.

The Japanese Electrical Association has asked the Government to issue regulations for electric light and power installations and has tendered its services in the preparation of a set of rules.

The Public Lighting Commission of Detroit, has asked for an appropriation of $353,000 for the coming year. Of this amount 110,000 is asked for extensions.

Defiance, Ohio, voters will decide the question of the issuance of a $30,000 bond issue, for a municipal lighting system at the coming spring election.

The Common Council of Hollidaysburg, Pa., has voted an appropriation of $12,000 for a municipal lighting plant.

The voters of Mohawk, New York, decided on February 15th, to build a municipal lighting plant.

Telephone and Telegraph.

It is stated that a submarine cable is to be laid by the Japanese between Formosa, the newly acquired island, and Japan. The length is 594 nautical miles, and the contract price £65,980. Great progress is reported in electrical matters generally in Japan, the latest project reported being the construction of an electric tramway between the towns of Uraga and Tokosuka.

The federal telegraphs in Mexico were substantially completed on February 1st, by the opening of the new line from Tehantepec to Acapulco. Every important point in the republic is now comprised in the federal network. The federal telegraph is absolutely removed from politics, and civil service rules are strictly applied.

Department Commander Wheaton offered for sale at Carthage, New Mexico, at public auction, on February 10th, the United States military telegraph line running from Carthage, New Mexico, to Fort Stanton New Mexico, a distance of ninety-eight miles. The property was to be sold as it stands, ready for use, or in parcels.

At a meeting of the stockholders of the Chicago and Northwestern Telegraph Company, held at 195 Broadway, on February 6th, the old Board of Directors was elected who afterwards held a meeting and re-elected Mr. T. P. Scully, president and Mr. A. R. Brewer, secretary.

The practibility of using pigeons as telegraph messengers has been demonstrated during a recent interruption of the wires between Sinferapol and Sebastopol, Russia, about forty miles apart. Fifty minutes was the average time of dellvery.

The Gamewell Fire Alarm and Telegraph Company has secured a contract for increasing the efficiency of the municipal system at Stockton, Cal., which amounts to a practical reconstruction of the entire system.

The Bell Telephone Company, of Buffalo, N. Y., has established a new exchange at East Aurora, N. Y., which service includes all the towns along the line between those two terminals.

Astoria, Oregon, has just been furnished with a municipal fire alarm system of eight boxes, which can be readily enlarged in the future.

Railways.

Comparative figures of the coal consumed per car-mile run on French tramways, employing different methods of propulsion, are contained in an article on electric lines by E. Cadiat in the *Portefeuille Économique des Machines*. As regards storage battery traction, on the lines from St. Denis to the Madeleine and from the Opera to Neuilly the car-mileage aggregated, in 1893, 502,060, or 1,376 car-miles per day. The steam engines at St. Denis furnished for this service a total of 6,500 H. P. or 4.72 H. P. hours per car-mile. M. Badois, who reported these figures, gives 2.75 lbs. of coal as the consumption per horse-power hour, and arrives at 12.98 lbs. of coal per car-mile. At Marseilles, during the first two weeks of operation of the trolley system,

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150,348 lbs. of coal were consumed to run 19,970 car-miles, and during the second two weeks 150,975 lbs. for 18,983 car-miles. The average is 7.73 lbs., which, however, includes the coal used in connection with the lighting of the cars and the power station.

It is reported that the Milwaukee, Racine and Kenosha electric railway has now a right of way for the whole distance of the proposed line. Oak Creek was the last town to grant a franchise. This franchise provides for cheap fares. Not more than a five-cent fare can be charged in the town, and in case feeders or branch lines are built transfers will have to be furnished. The company will begin the work of construction as the weather permits. The franchises which have been granted provide for a road to be operated by electricity to carry passengers and freight. At Kenosha it is to connect with another electric road which will run to Chicago. This will make it a through line to the big city. It is provided that stops shall be made at every cross-road in the state.

The South Platte Railroad and Power Company, which has just been incorporated, proposes to build an electric road from Denver to Cripple Creek, and to build up the business interests of the country along the proposed line. The route selected is up the Platte canyon to a point near Symes station, and thence through West creek to Cripple Creek. The heavy mountain grades, it is asserted, can be more easily overcome by electricity than by steam power. The mountain streams are said to provide ample power for the generation of all electricity needed, while the cost of fuel is eliminated.

The South Chicago City Railway Company announces that twenty-four tickets will be hereafter sold for one dollar, or six for twenty-five cents.

Electric street car companies in Tacoma, Washington, are to be required to repair all damages to water pipes caused by electrolysis. In repaving one of the principal avenues of the city, along which runs an electric car line, it was found that more than one-half of the surface and connecting pipes, running from the water main to buildings, had been so eaten away by the electric current grounded through the rails as to be useless. The pipes were replaced by the city at a cost of more than $1,000. All franchises hereafter granted will contain a clause that the company shall repair damage thus caused.

It is announced that the Electric Storage Battery Company has contracted with the Union Traction Company, of Philadelphia, to equip two of its power-houses with storage battery plants. The aggregate of the contract is $150,000. The batteries will be used to conserve the surplus energy generated during the hours of light travel and render it available during the hours when travel is heaviest.

The Ottawa, (Canada), Land Company, which is composed of a number of the stockholders of the Electric Railway Company, of Ottawa, has offered the Westinghouse Air Brake Company land and water power for the establishment of a branch of its business in Canada.

Kourak, Russia, is to be invaded by the trolley. A company with a capital of $200,000 has been formed and obtained a franchise. The system, it is expected will be in operation by August 1st, next.

The City Electric Railway Company, of Decatur, Ill., has inaugurated its sale of thirty tickets for one dollar. On the first day 89,000 tickets were sold.

NEW APPLICATION OF THE "BOOSTER" SYSTEM.

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CORRESPONDENCE or other matter intended for publication, in any issue, must reach us not later than the 10th and 25th of each month. Our readers are invited to make use of the columns of THE ELECTRICAL JOURNAL for any discussion that will promote the interests of Electricity, either from an educational or commercial standpoint.

VOL. 1. CHICAGO, MARCH 1, 1896. NO. 19.

Universal Installation Rules.

The delegates appointed by the various electrical and quasi electrical organizations to co-operate with the National Electric Light Association in the preparation of a universal system of installation rules, will meet at the rooms of the American Society of Mechanical Engineers, 12 W. Thirty-first street, New York, on March 18th. The purpose of the meeting, as will be learned from the announcement in another column, is to formulate in convention, a set of installation rules, which by endorsement of the various organizations invited to participate, may be generally accepted throughout the country.

That some such action as this is greatly needed, no one will question who is familiar with the misunderstandings that constantly arise concerning the work and material involved in electrical installations. The only point open to discussion is the method of procedure. With the exception of one fatal defect, those having the matter in charge have proceeded with great judgment and care. They have invited delegates from all the large private corporations in the country, from the architects, fire underwriters, etc., etc., and Captain William Brophy of the Boston Public Service.

They have failed to invite into the council, the representatives of the large cities of the country, who are more vitally interested in this question than any other set of men. These inspection departments of the cities know more about the intricacies involved, have done more than any or all the organizations named in the announcement, and will have more to do with the question in the future. No set of rules can be made worth the paper they are printed on, unless the municipal governments will use them, and it goes without saying that they will not use them unless they have a voice in their formulation. We do not think the meeting can amount to much under the circumstances.

* * *

Expert Service Again.

The economical management of central stations is a subject, which has been the title of more papers before electrical associations than perhaps almost any other subject that could be mentioned, and is still unfortunately given the least attention—except in theory, and before societies. The very considerable number of small municipal lighting plants that exist in this country afford a ready index of the character of the help employed, for a careful perusal of the statistics which are given in the press of those cities shows that the general rate of wages paid to the employees is such that competent, reliable men could, by no possible stretch of the imagination, be supposed to be in charge.

In such small plants it is generally the rule that the engineer is "the electrician" and we are in a position to say that the information possessed by these so-called electricians is limited to a sort of thumb-rule knowledge of the superficial features of the system in their charge and a complicated vocabulary of electrical terms, the whole forming a curiously inanimated load of intellectual lumber.

One of the largest cities of the south, with a magnificent central station, has for its chief engineer and electrician a Mississippi steamboat engineer, who, in his time, was not considered a particularly good engineer for even river work. To any one who is acquainted with this class of engineers, nine-tenths of whom, do not even know what an indicator is, much less what can be learned from it, this statement means volumes. Electricians in charge of central stations, who are receiving $40 per month, can hardly be first-class men. First raise the standard of expert service, and the rate of compensation will raise itself.

* * *

Perhaps This Is British Humor.

What induced the *Canadian Engineer* to publish, or what possessed Mr. William Golding, a civil engineer of New Orleans, to write an article on "Overcrowding in the Installation of Generators," is one of the things past finding out and certainly reflects no credit on either of them.

Mr. Golding says: "It is the practice to install as many electric generators in a given area as the floor space will admit, never thinking that the electric fluid which is being gathered from the atmosphere may become exhausted. The object of this note is to direct attention to the probable fact, that as all of the known ingredients of the atmosphere may be separated, the quantity of electricity collectable upon a given area may be limited. As is well known, the life-sustaining property of the atmosphere, whether for animal or plant life, becomes exhausted by overcrowding, thus suggesting that the supply of electric fluid over a given area may also become exhausted by excessive and continual withdrawal. There are many well-equipped and seemingly well-installed electric generating plants that do not deliver the current of which they are theoretically capable, and there are also many electric plants to which large additions of power have been made wherein no satisfactory results have followed, in which the failure may be due to overcrowding."

There seems to be a joke concealed in the matter somewhere, but it is difficult to tell whether Mr. Golding is playing it on the *Engineer* or *vice versa*. Any way, the first of April is not here as yet.

* * *

The World's Fair Still Before Them.

In discussing the proposed electrical features of the Paris Exhibition of 1900, M. W. de Fonville makes the following remarks in *L'Etincelle Electrique:*

"Just at present, the authors of the proposed improvements in the Champ de Mars and the Champs-Elysees are preoccupied only with the theatre in which their grand play is to be given, and not with the play itself. They have written and perorated as if Paris was lacking in monuments with which to excite the admiration of strangers. They have confounded our old city, so rich in architectural beauties, with a city of upstarts like Chicago which was obliged to improvise artistic structures which she could possess in no other way."

All of which, being interpreted by an *upstarter* is simply the old, old story of the fox and the grapes. No, let Paris not try herself along Chicago lines! Let her set her face toward some ideal landmark of her own. Be it remembered, there is only one Paris—but there is also only one Chicago!

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Evidences of British Progress.

Our British brethren are making great strides in the commercial applications of electricity. The current number of *Lightning* (London) has six important announcements which indicate the greatest progress in that direction. Hyde Park is to be illuminated with arc lights and a half-page cut is given showing the beauties of the proposed scheme; the Tunbridge Wells corporation's Common Council chamber is to have an electrical fan; the Lord Mayor of Manchester wants to establish a municipal system of telephones; experiments in the electric lighting of railway cars have been made; the Halifax Parish Church is to be lighted by electricity and the landing stage at Liverpool when the Campania came in on her last trip was *brilliantly* illuminated with ten arc lights for the first time, the display of light being characterized as magnificent. "Verily the world do move," and even England moves with it sometimes.

* * *

Would Have Hypnotized the Enemy.

L'Etincelle Electrique comes forward with the statement that during the reign of the last Commune in Paris, a young Alsatian inventor proposed to Mr. Henri Rochefort a scheme for the electrical defense of the barricades.

It was proposed that large copper cables be buried underground, and when the enemy approached, a powerful current was to be sent through them which would electrify a large area in their immediate vicinity, and any troops who should be in these areas, would be rendered motionless, and could be disposed of at leisure.

If there were only a few of the veterans of the Revolution left, one might be found who might offer such evidence as to enable us to recover the credit of the discovery of electrical defense, but we should certainly resent any allusions to "Washington or Franklin as L'exterminateur.

* * *

Specifications.

We intend to publish in full in our next issue, a set of specifications for arc lamp posts drawn by Mr. Foree Bain, Engineer to the Board of West Park Commissioners, Chicago.

We believe the questions of specifications is one to which too little attention is paid by the engineering profession and we are quite certain that the better specifications are—the more clearly put—the better it will be for the manufacturers—the easier and cheaper it will be for them to figure out what is wanted. We think enough of this matter to devote considerable space and thought to it. At intervals from now on, therefore, we shall publish specifications which we think are entitled to special commendation for the guidance of those who desire to purchase electrical machinery, but more for the help that such specifications will be, either in the way of guidance or warning, to the electrical engineering profession.

* * *

Our Neighbor's Wail.

We have been asked repeatedly lately why our blue Monday contemporary is so desperately stirred up against THE ELECTRICAL JOURNAL. People who ask the question fail to compare the present weekly attempt with what the *Western Electrician* used to be in the good old days when it carried the great and boundless west around in its breast pocket. The pocket-book of our esteemed contemporary is his only vital spot, and when that is touched he raises a wail. It is that wail with which our friends and neighbors have been regaled lately.

We will hear more of it before we hear less.

* * *

Now, if it were to pass on the intrinsic value of a well supported but lonely pair of deuces in a game of freeze out, or on the exalting and refining influence of a combination of wine, women and song, as complement for an evening's entertainment, we should, without argument, admit the superior qualifications of our esteemed contemporary of blue Monday tendencies—but as a court of last resort on a question of scientific fact—he is by nature, education and inclination barred.

Newspaper Modesty.

Our esteemed contemporary in *blue* apologized some weeks ago for the fact that a fire had so put it out that it was not, for that week, up to its usual high standard. (It was a pretty poor effort.) The London *Electrician* in commenting on the matter suggested that if the editor had not so stated no one would have discovered that the paper was worse than usual. Now our neighbor is bowing and blushing its thanks, regarding the left-handed fling as a compliment. It takes mighty little to please some people.

* * *

Naming the Baby.

With characteristic modesty a number of our electrical contemporaries have rushed forward in the effort to coin a new word or words to suit the Roentgen discovery. In this they have been aided and abetted by nearly every one who has in any way experimented with the new process. Decidedly the worst set of words has been put forward by the *Electrical Review*, which combines "Radius" from the Latin and "graphein" from the Greek, into an apparently smooth sounding set of terms.

By all means, let Dr. Roentgen christen his own baby.

* * *

The *Electrical Engineer* of London has sprung into the breach and humanely christens the new Roentgen process "electrosciography." It explains that this term means electro-shadow-printing, but the plain English appellation might be objected to on the ground that some would claim that it was no such thing, but would, to speak plainly, be too lazy to trace the new word out from the original Greek. It seems to us that, with the connivance of the British Institution, the *Electrical Engineer* would have made the word still more forbidding of investigation and thus made its new word absolutely unassailable.

* * *

A franchise has been asked for in Rome for two electric street railways. The municipal authorities object to the overhead trolley on artistic grounds, and the lines are therefore to be of underground construction. Just think of the spectacle of a Roman Senator in his toga, treading his majestic way to the heaven-vaulted forum—run over by a trolley car! Et tu, Roma!

* * *

One of the newest and most likely claims for the cathode ray is that it has the power to detect an ingrowing desire for cheap notoriety. "Eminent scientists" of the newspaper type should be careful to keep out of focus.

* * *

No bank or safe deposit company will be safe in future. Burglars will undoubtedly use the "X" ray to ascertain the vault combinations, and nitro-glycerine and dynamite will be out of order.

ELECTRIC ILLUMINATION FOR THE GODS.

The temples of India are to be lighted with electricity, the example having been set by the great shrine of Siva, at Kochicaddie, near Mulwal, in Ceylon, and is to be speedily followed by the equally vast and ancient foundation of the Nathkotta, in the same island. In no long time others will adopt the same improvement till all the holy places of the peninsula are so equipped, that by pressing a button they can be instantly illuminated, like a modern hotel or theatre. The innovation is enough to make Siva and Vishnu, and even the great Brahma himself gasp and stare. There are some three million gods in the Hindoo pantheon, more or less, and they are entitled to a degree of surprise at the introduction in their shrines of a miracle surpassing any of their own. The old cressets of bitumen and flickering lamps of perfumed oil, which shown around them age after age since the days of Sesostris and Scylax gave way finally to Pennsylvania petroleum and illuminating gas, now substituted by the nimbler and more radiant flame bright enough to purge the temples of their shadowy gods and spread the glow of a more wholesome and rational faith around their altars.

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IRON CLAD ARC ARMATURES.

The Western Electric Company has Produced an Armature for Arc Light Dynamos that is Practically Indestructible.

SEVERE AND SUCCESSFUL TESTS WERE MADE.

Realizing that the iron-clad armature has almost completely driven the surface wound machine from the market, in constant potential work, the Western Electric Company has designed and put in service a complete line of arc machines having iron-clad armatures and other new features.

These iron-clad armatures have been in use in increasing numbers for over a year without the loss of a single coil. This is a practical demonstration of the possibility of insulating an iron-clad armature for high voltages, and once having accomplished that task, the mechanical superiority of the iron-clad armature is unquestionable. The man who has spent twice as much time in replacing the bands on a burned out armature, as he has in rewinding a burned coil, will appreciate an armature in which the knocking out of a wedge gives complete access to a coil.

The general form of construction of these machines is shown in Fig. 1. The frames are of the bi-polar, horseshoe type, with the magnets horizontal. The magnet cores are of wrought iron and the pole pieces and yoke are of cast iron.

The pole pieces are divided in the center, thereby greatly reducing the cross magnetizing action of the armature. The pole pieces are so shaped that when the regulator is set to give an absolutely constant current at any load, the field will be of the right strength to give the predetermined slight amount of sparking in whatever position the brushes may be set.

The bearings are of the self-oiling, self-aligning type, and are provided with visual oil guage and drain. The pulley end bearing is bolted directly to the yoke of the dynamo and the commutator end bearing rests on a brass bracket projecting from the lower pole piece. The bearing bracket is bored out at the same time the pole pieces are bored, so that the removal of the armature is a very simple matter. The bolt can be taken out and the bearing turned around the shaft until the foot is clear of its seat and the armature will then rest in the pole pieces and the bearing can be slid off with a very slight exertion.

The simple fact that the armature may be so easily and quickly removed for examination or repairs is a point that is fully appreciated by all central station managers. The bearing may be removed in about five minutes, the pulley in three and the commutator in ten. It may be remarked here that the time occupied by one man and helper in winding an armature coil is, on the average, fifty minutes for an 80-light machine, which is about an average size. The bearing seat affords a very convenient place in which to rest the armature, thereby doing away with the necessity of removing the armature completely from the frame.

The most vital part, in all dynamos of high potential, is the armature. If the armature is not thoroughly insulated and designed for comparatively cool running, the machine is destined to a short life.

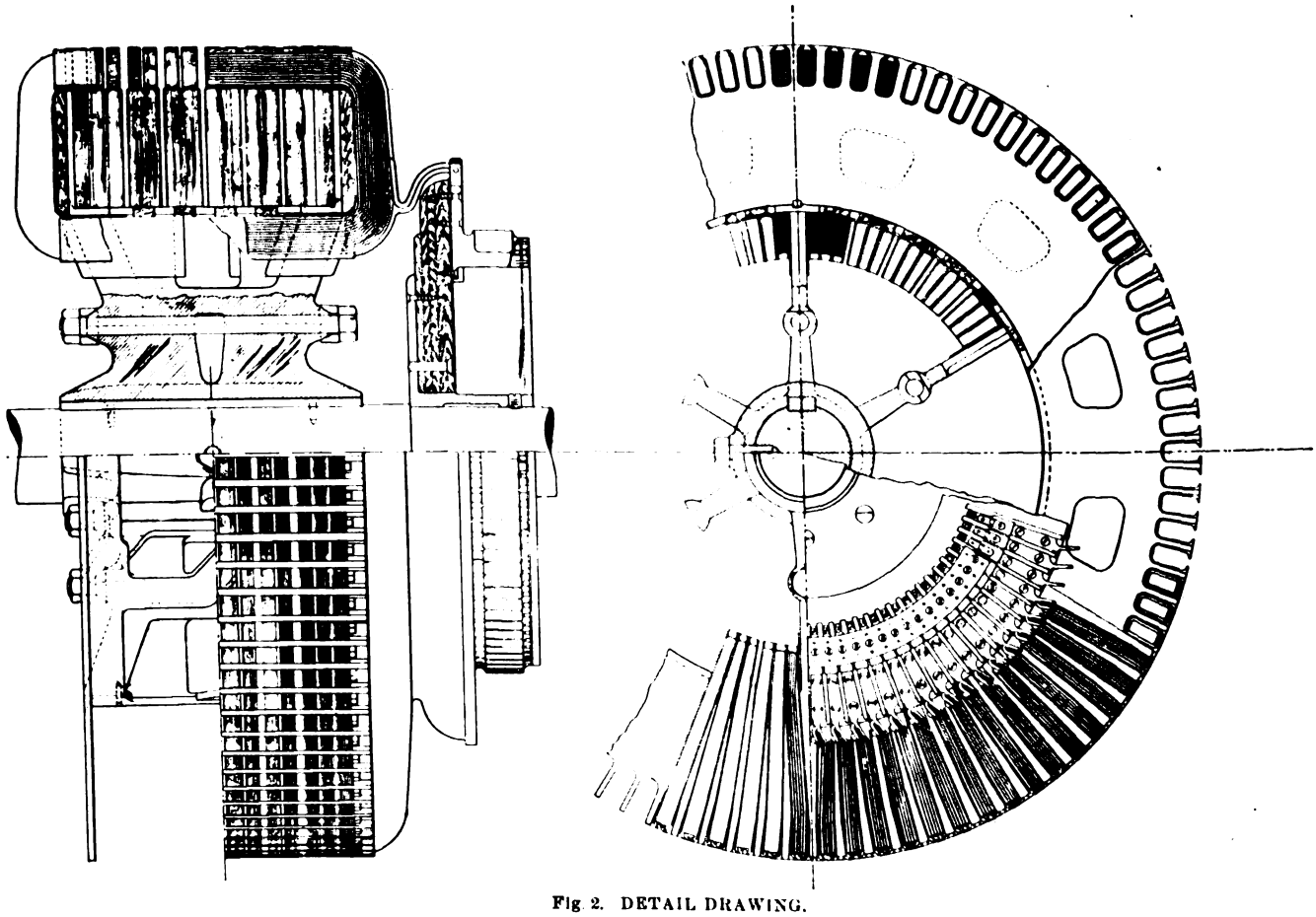

Fig 2. DETAIL DRAWING.

The care taken in procuring first-class insulation of the armature is shown in Figs. 2 and 3, which can readily be understood by reference to the following description:

The armature is built up of very thin sheet-iron rings mounted on a brass spider. The sheet-iron rings have teeth similar to those in the standard incandescent iron clad armature; the coils are wound in the slots between the teeth and are firmly held in place by wooden wedges, which are driven in over the top of the winding. The armatures are divided into a very large number of coils of comparatively few turns of wire. In this way the voltage in the individual coils is reduced to such a small amount that there is very little strain on the insulation between coils and the voltage between segments of the commu-

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tator is so low that it is difficult to flash the machines under ordinary running conditions, and if flashing does occur, the effect on the commutator is scarcely noticeable. By dividing the winding into a large number of small ventilated coils the accumulation of heat in the center of the coils is avoided, thereby preventing the slow roasting of the insulation which occurs in some machines.

The coils are insulated from the core in the slots by a trough which is built up of alternate layers of press board, mica and

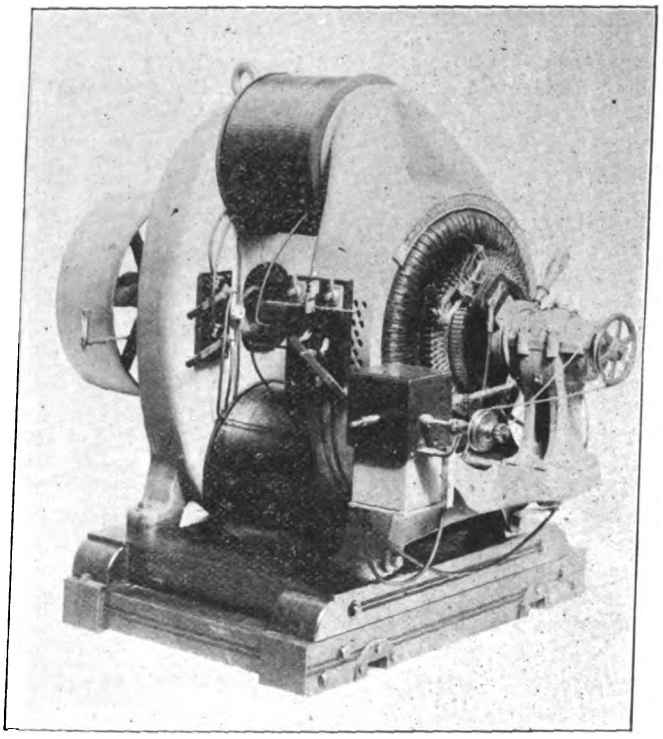

Fig. 1. IRON CLAD ARC DYNAMO.

oiled paper, the sheets of mica being well lapped to avoid any chance of puncturing at the joints. The coils on the inside of the armature are wound in insulating troughs somewhat similar to the troughs in the slots, with the exception that they are narrower and deeper. The ends of the coils are insulated from the core; first, by wooden rings which are placed at the ends of the armature and form rounded corners to wind over as well as affording additional insulation; second, by built up "U" shaped troughs which overlap and extend in and around the inside and outside troughs, so that the result is that each coil is wound in a separate trough built up of four overlapping troughs which effectually insulate it from each of the other coils and from the core. A complete trough is shown separate from the armature in Fig. 3.

The advantage of this form of construction is at once evident in case repairs become necessary, as any coil can be rewound without affecting the other in any way, and as there are no bands all that has to be done is to slip the armature far enough out of the pole pieces to work on it, and then take off the commutator, rewind the coil and put the armature and commutator in place again.

The 100 and 125-light armatures have a large space between the inside of the armature and the spider. On the 80-light and smaller machines the construction of the brass spider is such that the shaft and the greater part of the hub and spider can be taken out from the inside of the armature, so that there is a great amount of space on the inside of the armature and the facility for winding is very greatly increased. The inside and outside parts of the armature spider are drawn into perfect alignment again by six bolts with taper collars, as shown in Fig. 2.

In case one or even four or five coils in an armature become injured it is not necessary to rewind them at once, for if a coil is not short-circuited internally the terminals of the coil can be simply disconnected from the clamp on the commutator and a small jumper put across the same segments to which the coil was previously connected, and the machine can be run with no serious increase of sparking.

If any of the injured coils are short-circuited internally of course the short circuit must be gotten out, or the whole coil may be cut out with a cold chisel. If this is done, it is necessary to take out the opposite coil also in order to keep the armature in running balance. A wooden wedge inserted in the place of the inner portion of the coil will serve to hold the other coils in place.

The following table shows the result of a test made on an 80-light machine, in which armature coils were cut out at various points:

Number coils cut out.	Volts.	Amperes without the use of Reducing Switches.	Length of Spark.	Location of Coils.
2	4300	10.4	¼-in.	Adjacent.
3	4250	11.4	½ "	"
4	4200	12	¾ "	"
8	4000	11.4	¼ "	Bunches of 2.
12	3800	12.2	⅜ "	" " 3
16	3600	10 4	¼ "	4 Bunches of 2 and 8 single coils distributed around the Armature.
16	3600	13.2	¼ "	Bunches of 4.

The spark is somewhat increased in length, but is not of a nature to damage the commutator.

The current may be redueed from that shown in the table to the normal amount, by the use of the reducing switches, without materially affecting the length of spark, as will be seen from the following test:

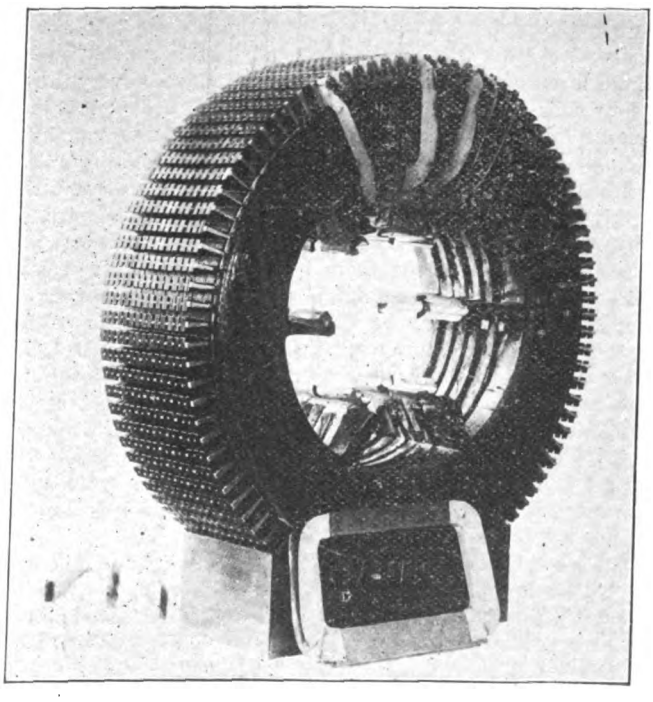

Fig 3. ARMATURE CORE, READY FOR WINDING.

A five hours run was made, with sixteen coils cut out in four bunches of two and the other eight unequally distributed about the armature. The current was ten amperes and gave a quarter inch spark. At the end of the run there was no sign of undue heating and the commutator was not injured in the least.

The all important factor in producing long life in an arma-

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ture, after good insulation has been secured, is that of ventilation. The many tales of woe originating from the slow roasting of insulation, led the designers of these machines to take special precautions to prevent the accumulation of heat in any part of the armature as well as to prevent the general heating. The success of the system of ventilation adopted is shown by a test in which two armatures were built just alike except that one was wound in the usual way, and in the other the coils were ventilated as shown in the cuts and described below. The former heated 80 F above the air after a 12 hour's run, while the latter only heated 60 F after a 24 hours' run.

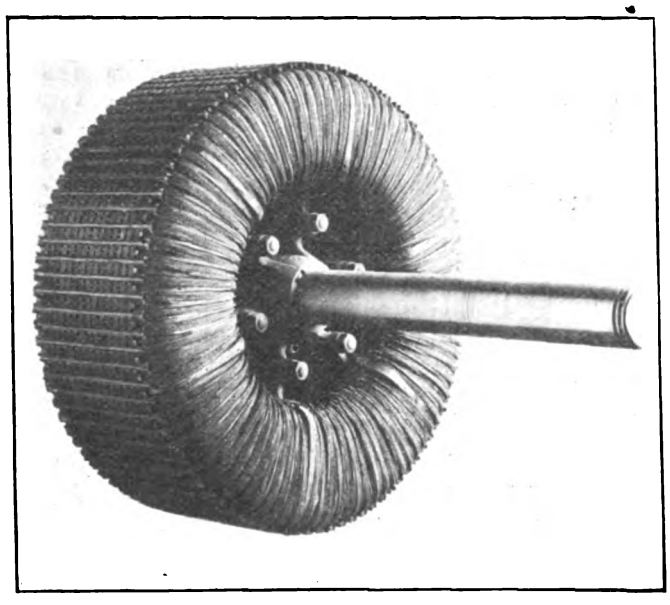

Fig. 4. ARMATURE COMPLETE, PULLEY END.

The armature discs are supported by extensions on the spider. These points of support which are about two inches wide are directly over the spider arms as shown in Fig. 2. Between the spider arms, in the open spaces, are laid small wooden blocks about one quarter of an inch thick which separate the armature coils from the discs and between every three or four coils on the inside of the armature are ventilating spaces. These ventilating spaces which are shown very plainly in Fig. 2 open into ventilating chambers in the brass ring which carries the armature discs and this space communicates directly with the spaces between the iron discs which are, of course, open at the outside where the iron teeth come between the coils. By this means there is a free circulation of cool air in through the coils, coming in at the bottom and flowing up through the ventilating spaces between the armature discs and out between the armature teeth. In addition to this the brass spider arms are partially cut away where they pass through the winding at the bottom so that there is an additional opening for the admission of fresh air into the spaces between the armature rings. The iron armature rings are held apart in bunches of about sixty, by radial strips of asbestos which, from their action as a centrifugal blower, tend to keep the cool air flowing through the armature.

The special feature of this system of ventilation and insulation is that the entire ventilating space in the armature may be filled up with carbon or copper dust leaving the insulation of the machine as strong to resist the breaking down strain, due to the voltage, as it was before, for the reason that each coil is insulated independently of the rest in a trough which completely protects it.

The mechanical superiority of the iron-clad armature over the surface wound is most apparent when necessity requires it to be handled, either in placing it in the dynamo or moving it about the station. It may be rolled about the floor without injurious results as it is absolutely puncture proof.

The field coils are wound on paper spools $\frac{1}{8}$ to $\frac{5}{16}$ of an inch thick, which are built up and flanged over outside of the $\frac{1}{4}$-inch wood veneering heads. The spools are held away from the iron core and the yoke and pole pieces by wooden wedges so that there is a large ventilating space all around the inside and at the end of the spools. The construction of the spools is such that should this ventilating space become filled with dirt the coils are still effectually insulated.

On the yoke of the machine shown in Fig. 1 is mounted a pair of reducing switches which cut out part of the field winding.

The lower switch is for the purpose of adjusting the spark at the brushes to the conditions under which the dynamo is running. When this switch is open the machine will run along without flashing under normal conditions, though the spark is in this way reduced practically to nothing. If there are sudden and great changes of load, it is desirable to have the machine run with a slightly longer spark so that it will not flash before the regulator has a chance to compensate for the change in the load; this can be accomplished by simply closing the switch.

The other reducing switch is for the purpose of reducing the current output of the dynamo so that if it is desired to run the machine part of the time at a lower current than 9.6 amperes this switch can be closed and the regulator adjusted to the lower current. In this way considerable fuel can be saved when it is not necessary to run the lights at full brilliancy.

The commutator, which is shown in detail in Fig. 2 and complete in Fig. 4, is built up in a very substantial disc of hard wood veneering, which is mounted on a brass flange. This wooden disc is then faced with mica and each segment is screwed to it independently of the others. The segments are tapered slightly towards the inside, allowing slate wedges to be driven in between them, thereby protecting the mica facing from the action of any burning that might be caused by the flashing of the dynamos. The outside ends of the segments are held rigidly by a compound ring of mica and veneering, and each segment is held in position on this ring by a machine screw and two dowel pins. The segments are insulated from each other by air spaces allowing both sides of each segment to be perfectly

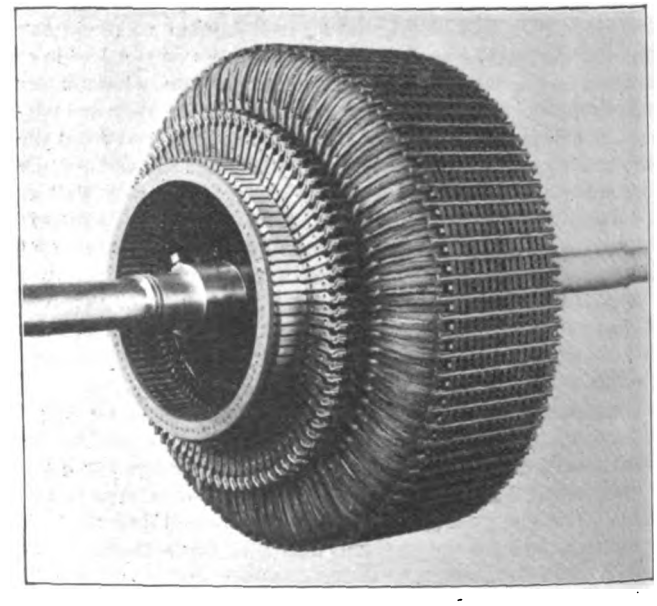

Fig. 5. ARMATURE COMPLETE, COMMUTATOR END.

inspected and cleaned at any time when the machine is not running.

With an air insulated commutator the burning effect of flashing and short circuits is confined almost entirely to the brushes so that it is not necessary to turn down the commutator after bad flashing, as the case with solid-built commutators. The carbon brushes feed down and compensate for the burning as soon as it is over. All parts of the commutator, which are connected with the circuit of the machine, are on the face of the

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wooden disc so that there are no parts behind the commutator which have to be cleaned to keep the insulation from running down. Also all screws used in its construction are accessible from the front. The segments are increased in size at the working part so as to provide for a long life, and also to hold the flashing as much as possible in the working part of the segments.

This form of construction has the additional advantage that it is not dependent on slate or rubber or any other brittle material for its mechanical support, and yet the mechanically substantial insulation is thoroughly protected by the slate wedges from the burning action of flashing.

The brushes are arranged to cover the commutator over the entire angle spanned by them, and whatever sparking occurs, is concentrated at the tip of the brush. At the brush tip is provided a small independent brush which is automatically fed down to compensate for the increased wear due to the sparking at this point. This independent brush is so narrow that the brush angle remains practically constant, no matter how fast the brush may be worn away by sparking. The tension of all brushes, there being four to each holder, is adjusted by vulcanite handles, carrying a worm screw, which slip down over ratchets; by turning the rubber handle carrying the worm screw the brush tension can be adjusted accurately, and when it is desired to replace a brush the handle and brush spring can be removed entirely from the brush holder and the carbon taken out and inspected or renewed.

In some of the older forms of carbon brush-holders used on air insulated commutators considerable annoyance was experienced from the noise caused by the chattering of the brushes. This has been almost entirely obviated by the construction adopted. In these brush-holders the main brushes cover several segments at once and all the brushes are urged by springs in the direction in which the commutator rotates, so there is no chance for the brushes to vibrate. With these brushes it is not nceessary to oil the commutator.

The connection board has a substantial slate base on which is the line switch and lightning arrester. The lightning arrester is shown at the top of the board in Fig. 1, and consists of two carbon pencils, one connected to each side of the line, which are held horizontally and in close proximity with a grounded carbon plate midway between them. As soon as the lightning jumps across, the arc is almost instantly blown out by the field from the pole-piece of the dynamo. The arresters have been found to work very satisfactorily in long continued and severe storms.

The lamps can be thrown off or on in groups equal to 10 per cent of the capacity of the machine from full load down to short circuit or *vice versa*, and the regulator will compensate for the changes without flashing the machine. Or the whole load may be thrown on or off iustantly and the regulator will compensate for the change in a few seconds.

The machines withstand without injury the ordinary accidents of operation, such as open circuit and short circuit, and either side of the circuit may be grounded to the frame and the circuit opened without injuring the insulation.

A test was recently made to ascertain the rise in potential at the terminals of an 80-light machine. A load of ninety lamps on a very short line was put on the machine and the line opened as nearly instantaneously as possible at the switch-board. The potential was taken at the terminals of the machine with a Weston volt-meter. With the machine running at 4,500 volts the volt-meter swung up to 5,500 volts; when the circuit was opened, at a load of 3,300 volts, the needle swung to 4,400. This shows that there is no marked difference between the iron-clad and surface-wound machines in this respect.

If the circuit had been opened in the middle of a long line the rise in voltage and consequent strain on the insulation would have been so small as to be hardly worth figuring on.

The machines are all designed to run fourteen hours on any load from dead short circuit to full-rated capacity without heating in any part more than 70 degrees Fahrenheit above the surrounding air.

SWITCHING OF BRIDGE CARS.

Brooklyn Bridge to be Equipped With Electricity for Operating Cars at Both Terminals Preparatory to Exclusive Electric Service.

GENERAL ELECTRIC COMPANY DOES THE WORK.

There has been much talk recently concerning the proposed operation of electric cars on the Brooklyn bridge, and the auxiliary electric operation of the switching system.

The first official exhibition of electricity as applied to the switching of the cars was made February 8th, at 11 A. M. in the presence of President Howell, Vice-President J. Seaver Page and Trustees Keeney and Henriques. The motor car was coupled to three of the ordinary passenger cars and the complete train of four cars was switched by the motors from the incoming to the outgoing platforms and thence to the cable sheaves several times. The car was then taken over the complete bridge circuit twice. Complete satisfaction was expressed by the President and by Chief Engineer C. C. Martin, at the manner in which the work was performed.

The use of electricity in place of steam for switching the cars at either end of the Brooklyn Bridge has been recognized as the only suitable method, ever since the electric railway motor

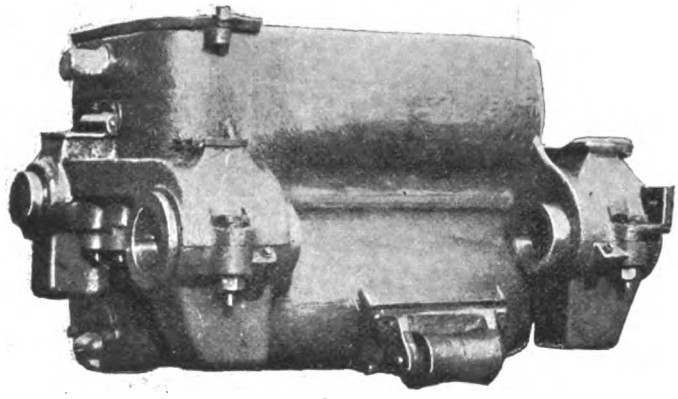

Fig. 1. MOTOR.

became a practical fact. But not until the motor had been adopted to heavy train service and had proved successful on the West Side Elevated Road at Chicago, the Nantasket Beach Division of the New York, New Haven & Hartford R. R., and on the Baltimore & Ohio main line, did its employment in the Bridge service become possible. Experiment is not a function of a municipal body, such as that governing the operation of the Bridge, consequently it hesitated to apply electricity to Bridge traction service, until it was certain that, if applied, it would work without a hitch. The Chicago road has been running without a break of any kind since last June; the Nantasket Beach Road was operated, during the summer, without the slightest trouble, and the electric locomotives of the B. & O. Road have been conducting the entire freight service through the tunnel since the 2d of August last. Trustees Howell, Henriques and Page, together with Chief Engineer Martin, have visited these roads and have become convinced of the practicability of handling the bridge trains by electric power.

To enable the Trustees and the Engineer the better to judge of the advantages which electric motive power might offer over the steam power hitherto employed for switching service, bids were called for for the proposed electrical equipment. Consideration was only given, however, to two propositions, that of the General Electric Company, which had already fully developed apparatus applicable to heavy electrical traction work, and which equipped the three roads above mentioned, and that of the Westinghouse Company. The latter concern declined, but the General Electric Company responded offering to fully equip one car, operate it for thirty days, and at the end of that

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time, if the result were not satisfactory, to restore the car to its original condition and bear the cost of the experiment.

If the general plan adopted at first proves economical as well as satisfactory, a certain number of cars will be equipped with four motors, one on each axle. These cars are to be known as motor cars, and each will remain with its own train at all times, switching it from the incoming to the outgoing tracks and pulling or pushing it over the tilting sheaves, where the grips will take up the cable and the motors cease work. Should the grips slip while the train is mounting the 3.78 grade, the motors can come again into requisition and assist the trains over the summit. Moreover, during the early morning hours, when traffic has become light and the cable is no longer running, the trains can be operated entirely by motor cars, as they are now by the locomotives. The eventual outcome will probably be the exclusive operation of the Bridge Railroad by the motor cars. Meanwhile, they will switch the trains, and as each train is equipped with its own switching power—the motor car—all the interference which the steam locomitives have hitherto placed in the way of the incoming and outgoing trains will be done away with above mentioned. The motors are known as the G. E. 1,200 from the fact that under normal conditions each will exert a horizontal effort of 1,200 lbs., when mounted on a 33-inch wheel. Four of these motors are employed, one to each axle or two to each truck. They are completely incased and are water and dust tight. The armatures are of the well-known type, the windings being sunk into slots in the armature core. The Eickemeyer winding is used in the armature. By this method the crossing of two wires of large difference of potential is avoided.

The insulation is substantial and each segment of the commutator is of hard drawn copper. The armature is mounted on a sleeve, keyed to the shaft, which may be withdrawn without interfering with the armature structure The field frame is of cast steel. The ratio of reduction between the armature shaft pinion and the wheel gear is 3.5 to 1.

Each motor weighs about 3,000 lbs. With this equipment and the regular train, a speed of about fifteen miles an hour may be obtained. Each motor is suspended on the truck from two trunnions in the upper field set in two bars, the outer ends of the bar resting on eliptical springs. The axle is thus relieved of nearly all the weight of the motor.

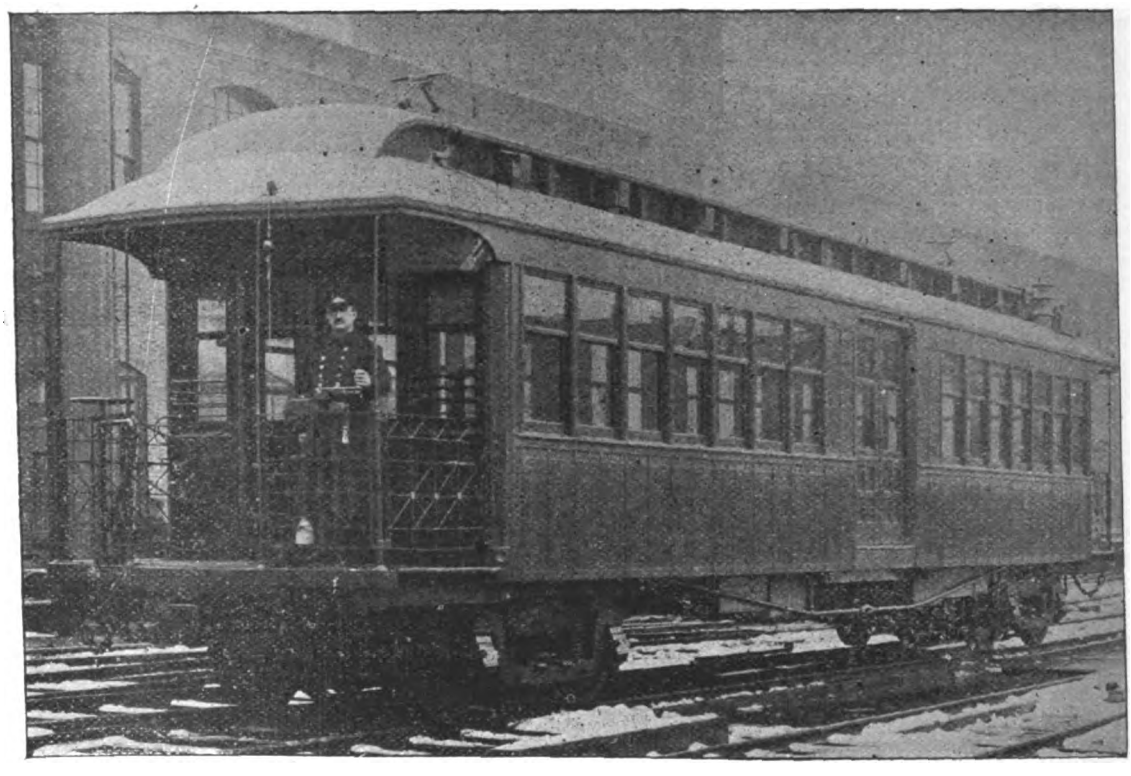

Fig. 2. BRIDGE MOTOR CAR.

and the complexity of the switching be greatly reduced. At present, the time consumed in switching a train is twenty seconds, and in that time a vast number of people gather on the platforms With the new motor and the new principle of operation it is expected that passengers will at all times have cars waiting for them.

Besides the gain in time in the switching process, all the inconveniences of the locomotives—the noise, smoke, steam and gases will be eliminated and this in itself will be no small gain.

Car No. 76, one of the regular passenger cars of the Brooklyn bridge was selected to receive the first electrical equipment. All the apparatus, with the exception of the controlling handles and circuit breakers were placed out of sight beneath the floor of the car. The ordinary light Pullman trucks on which it has hitherto run and the cable grip mechanism were removed. Heavier trucks were necessary to carry the motors. These were supplied by the McGuire Company of Chicago, and combine the best features of the passenger and locomotive truck.

The general character of the motor equipment is similar to that in use on the Chicago Elevated and Nantasket Beach roads

At the base of each motor, facing the ends of the car is a small roller which depresses the cable and allows it to pass the motor without injury, while a long iron bar runs beneath the truck and depresses the tilting sheaves preventing them from striking the motor.

The operation of the motors is controlled by series—parallel controllers of the L 4 type, which have given such general satisfaction on the Chicago roads.

The indicating dial of the controller is placed at the top of the platform rail and is lettered "series," "multiple" and "off," showing exactly the position of the controller itself. The reversing handle is a jointed handle, which can be placed on or taken off the reversing switch spindle only when the controller handle points to the "off" position, showing that there is no current in the motors at that moment. The controller itself has no effect until the long arm of this jointed handle is dropped into the "forward" or "reversing" notches in the reversing handle plate. There are two controllers, each operated from its

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own platform, and either controller will operate the four motors or any two of them as may be desired.

The resistances as well as the magnetic cutouts are also placed beneath the car floor. Beneath each hood of the car is an automatic circuit breaker, placed within easy reach of the motorman. The operation of this device is instantaneous and is an effectual safeguard against any accident to the motor. These circuit breakers take the place of the main circuit hood switches, but are wired in multiple with each other instead of in series. To guard against any possibility of one being closed while the motorman is at the other end of the car and desires to open his main circuit, only one handle is provided. The handle cannot be taken off without opening the circuit breaker and when removed the circuit is locked open. As the motorman must take the controller and circuit breaker handles with him when changing ends all danger of complication is avoided.

The car is equipped with 12 electric heaters, manufactured by the Consolidated Car Heating Company, of Albany, N. Y. This system of heating has been extensively adopted on the surface cars in the City of Brooklyn and the consequent abolition

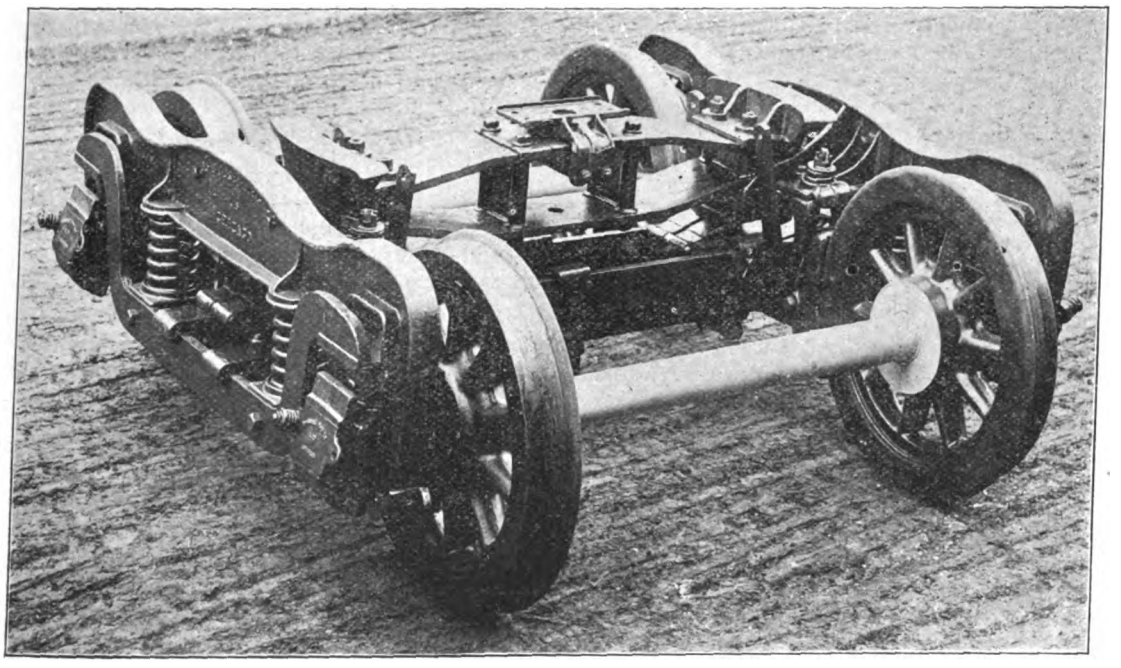

Fig 4. MOTOR CAR TRUCK.

of the objectionable stove has caused a general feeling of relief. The heaters consist of a marble slab of porcelain in front of which is a cylinder of porcelain wound with galvanized iron wire. These heaters have a maximum capacity of 40 square feet radiating surface at 400 degrees Fahr. Five different temperatures to suit the weather can be obtained by means of a controlling switch.

The collector which will take the current from the overhead wire is a diamond-shaped frame of metal set longtudinally upon the roof of the car and carrying at right angles a bar in the center of which is a roller. The arms are wide enough to preclude any possibility of missing contact. The diamond frame is depressable and expansible on the principle of the pantograph, allowing a play up and down to conform to the varying heights of the overhead wire. With this collector the trouble of reversing is entirely done away with.

The power to run the car was taken from the overhead wire already in position supplying current to the electric lights in the cars. The extra current, however, will be supplied from Fulton Street feeder of the Kent Avenue Station of the Brooklyn City Railway, the return wire being connected to the rails of the surface road.

PROPOSED NEW WIRING RULES.

National Electric Light Association and Other Organizations Will Meet March 18th in New York to Formulate Installation Rules for the Country.

WILL ASK FOR THEIR GENERAL ADOPTION.

The committee appointed by the National Electric Light Association to formulate, with the co-operation of similar organizations, a universal set of installation rules makes the following announcement of its plans through its chairman Mr. W. J. Hammer of New York:

On behalf of the Committee on Standard Rules for Electrical Construction and Operation of the National Electric Light Association, I take pleasure in sending you herewith a statement as to the present condition of the work undertaken by that committee for the forming of a joint committee, composed of the various electrical, insurance and allied interests, which Joint Committee, it is proposed, shall take up the most important matter of the codification, promulgation and enforcement of one standard set of rules which shall meet as fully as possible the conditions that now exist, be up to date, and prove acceptable to the various interests affected by electrical construction work.

The following organizations were invited to co-operate, and our committee is most pleased to state, that in every instance, the invitation extended has been accepted, and in the appended list are given the names of the delegates appointed to represent these various organizations, and the character of the appointments made is in every case so high as to guarantee a most careful consideration of the important questions to come up and their treatment in an able and conservative manner. The list of those who have been invited to co-operate with our committee together with their delegates, is as follows:

American Institute of Electrical Engineers, Prof. Francis B Crocker, Columbia College, New York.

American Street Railway Association, John A. Seely, Consulting Electrical Engineer.

National Board of Fire Underwriters, William H. Merrill, Chief Electrician, Chicago, Ill.

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Western Union Telegraph Company, A. S. Brown, Chief Electrician, New York.

Postal Telegraph Company, Francis W. Jones, Chief Electrician, New York.

American Institute of Architects, Alfred Stone, Secretary, Providence, R I.

National Association of Fire Engineers, Capt. William Brophy, Electrical Expert of the Commissioner of Wires Department, City of Boston, Mass.

American Bell Telephone Co., C. J. H. Woodbury, of the Engineering Staff, Boston, Mass.

General Electric Company, Lieut. S. D. Greene, General Manager Lighting Department, New York.

Westinghouse Electric and Manufacturing Company, Charles F. Scott, Electrician, Pittsburgh, Pa.

The committee of the National Electric Light Association who have had charge of the standard rules of that association for a number of years, and who have taken the initiative in the forming of the joint committee, are as follows:

William J. Hammer, Chairman, Consulting Electrical Engineer, New York.

James I. Ayer, Consulting Electrical Engineer, Boston, Mass.

Harrison J. Smith, General Operating Superintendent Edison Electric Illuminating Company, New York.

E. A. Leslie, Vice-President and General Manager Manhattan Electric Light Company, New York.

Capt William Brophy, Electrical Expert of the Commissioner of Wires of the City of Boston, Mass.

In view of various misconceptions of the Committee of the N. E. L. A. and of the Joint Committee, it will not be out of place to state that the various associations have been invited to send a delegate to the joint conference on March 18th, but not in any way was it intended to commit them to any definite action at that meeting It is proposed that the various rules that have been promulgated by the various interests, electrical and insurance, shall be taken up for consideration and thoroughly discussed from the standpoint of the various interests represented at that meeting, with a view of forming a new code comprising the best that is in the various sets of rules now in vogue and new matter considered advisable; that the delegates should take part in the discussion and vote upon the various matters which would come up bearing upon the importance and value of the rules submitted, and, after a code has been prepared which has met with the approval of the various delegates attending the meeting, that the code thus prepared should be submitted by the various delegates to the bodies which they represent with the intention that they shall ultimately, if it is deemed advisable by the various National organizations, be approved by them. As stated before, it is not the intention that the questions taken up in the discussion shall commit the various organizations to any definite decision in this matter at this meeting or thereafter, if they should deem it inadvisable to co-operate.

It seems almost unnecessary to call attention to the paramount importance of securing the adoption of one single standard set of rules. Examine the condition of things which exists to-day, in which we have the code of rules issued by the National Electric Light Association, which, as is well known, are largely the basis of all the rules used in the United States; the code adopted by the National Board of Fire Underwriters; the rules issued by the various illuminating companies; the rules of the Manufacturers' Mutual, of New England, and similar associations; the rules now about to be issued by the Fire Department of the City of New York, and similar organizations in other cities; the independent sets of rules prepared by consulting engineers, insurance experts, etc., which are, more or less, in vogue in the United States. Unquestionably, these various rules, which are all of them of greater or less importance, lead to a tremendous amount of confusion, misunderstanding, expense, litigation, and, I think will be generally admitted, frequently to the interpretation and enforcement of the various rules largely in accordance with the personal views of the local inspectors. By securing the adoption, promulgation, and enforcement of one single standard, which will meet with the approval of the various electrical, insurance and allied interests, and which rules shall be the result of the joint action of these various interests and not be fathered by any particular association, electrical, insurance or otherwise, we shall arrive at a condition of things which has been hoped for and worked for for many years past. It seems, then, as the preliminaries for the proposed joint meeting have been so successfully inaugurated, that it is the duty not only of the various organizations which are co-operating at this joint meeting, but electrical and insurance men, and those connected with allied interests should lend every assistance and encouragement in their power to secure the aimed at and much to be desired result of the adoption of a single National Code of Rules.

On behalf of the preliminary committee of the N. E. L. A., who are arranging the details of the meeting which is to be held on the 18th of March (and probably on the 19th as well), I wish to extend an invitation to anyone to send either to my address or to Mr. George F. Porter, Secretary of the National Electric Light Association, 136 Liberty Street, New York, any criticism or suggestion upon any of the rules now in vogue or matter which might be included in the proposed new code.

In conclusion, I take pleasure in stating that the American Society of Mechanical Engineers have extended the courtesy of the use of their headquarters at No. 12 West Thirty-first street, for the holding of the proposed joint meeting on March the 18th and 19th, 1896.

POWER TRANSMISSION IN THE SOUTH.

The electrical equipment of the extensive cotton mills of the Pelzer Manufacturing Company, one of the largest cotton goods manufacturing concerns in the South, is rapidly nearing completion. The motive power is derived from Victor Turbine water wheels driving three 750 Kilowatt three phase generators, wound for 3,300 volts. The water wheels turn at a speed of 164 revolutions per minute.

The electricity generated at the power house will be carried at a distance of three and a half miles to Pelzer, where it will enter the mills and drive the following motors:—one 400 H. P. synchronous motor wound for high potential, and three multiphase motors of varying capac ties from 5 H. P. up to 110 H. P. The majority of these motors will be of the inverted type, suspended from the ceiling in the different rooms. They will receive the current at a low potential from step down transformers placed in the sub-station at the mills. The mills will also be lighted from the same circuit.

The system, utilized in the operation of these mills, is the three phase system developed by the General Electric Company. By means of this system it is generally conceded that long distance power transmission may be most economically effected.

ELECTRIC OMNIBUSES.

Now that horse cars have been almost superseded by electric motor cars, 'bus companies in the European capitals are becoming uneasy, and are experimenting with various systems of electricity to replace horse power. Thus, the Omnibus Company, of Berlin, has recently made a contract with the Accumulator (storage battery) Company, of Hagen, Westphalia, who have guaranteed a type of 'bus, fitted with storage batteries beneath the passenger seats, which will meet all the requirements for 'bus traffic in a large city. These 'busses will not run in tracks, but any where on the streets, and are guaranteed to climb any hill of a grade less than one foot in ten. The accumulator storage battery will provide power for four consecutive hours, and the reloading, which is done by exchanging the exhausted accumulators on the car for others, will take but from two to three minutes. The only difficulty at the present moment for the acceptance of the project in Berlin is the necessity of creating a large, electric power plant for the purpose of loading and handling the Hagen accumulators.

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ELECTRO-THERAPEUTIC DEPARTMENT.

INDUCTION COIL CURRENTS.

No System of Measuring Alternating Currents Now In Existence That Is Satisfactory—Monell Method Will Not Accomplish the Purpose.

CANNOT MEASURE ELECTRICITY BY OHMS.

Ever since the movement began among electro-therapeutists to introduce instruments and methods of precision into practice, that would permit of repetition and verification of results, the necessity for a meter capable of measuring the induction coil currents has been recognized.

The galvanometer or milliamperemeter when introduced into the patient's circuit of a direct and uninterrupted current gives satisfactory evidence of the amount and direction of the current to which the tissues in the path of the current are subjected. For the direct or galvanic current this is the kind of information needed, since it is upon quantity and direction of current that we depend for most of the results that we seek to obtain by means of this current.

If, in the use of the induction coil, it is the amount of current that is flowing at any given time that needs to be known, there is, so far, no instrument devised that is capable of measuring it accurately, or at all. A very delicate galvanometer can give some approximate measurement of the primary induced current, since this is a current of one direction. But, by reason of the interruptions, the flow of the current at each impulse is too brief to permit the needle to come to rest. The secondary coil current is alternating as well as interrupted and although current meters are in use on alternating dynamo circuits none of these will register the small currents of the secondary induction coil, which seldom exceed twenty milliamperes.

In the physiological and therapeutic action of the induction coil currents the important factors are the amount of current and the electro-motive force of the current. It is to variations in these factors that the effects produced by induced currents are chiefly due. The frequency with which these variations are effected is an element of importance, it is true, but it is a subordinate one. A meter, therefore, that is to be of any material service in regulating the dosage of these currents must be constructed with reference to one or the other of these factors. In other words it should record either the voltage or the amount of current in the patient's circuit. In view of these facts, such methods as have been in use thus far for measuring these currents will appear crude indeed. To the best of our knowledge there have been up to the present time but two methods employed:

(1) A scale for showing the relation of the primary to the secondary coil.

(2) A graduated rheostat of high resistance.

The first of these methods may serve a useful purpose to an operator using the same instrument from day to day upon the same patient since it enables him to judge somewhat of the comparative strength of current which his patient can bear at different times. This he can do by noting the relative position of the coils as determined by the scale. But there are too many variable factors in the process for it to serve as a means of comparison of effects produced upon different patients.

Changing the position of primary or secondary coil, so that one overlaps the other to a greater or less degree—or, what amounts to the same thing—moving the temporary magnet or changing the position of its shield, if it has one, will modify, it is true, the strength of the induced currents in the coils by exposing the turns of wire to a greater or less number of magnetic lines of force so that a scale marked upon the magnet or shield or alongside the movable coil will serve as a crude indicator of the change made. But this scale is not to be seriously thought of as a measure of either current or electro-motive force. The induced currents depend first upon the strength of the battery or inducing current and second upon the length and number of turns and the size of wire used in the coils—as well as on the size and shape of the temporary magnet. Even if coils of the same maker are always alike in construction, which is seldom the case, the inducing current furnished by the primary battery will vary greatly in strength at different times and so modify the strength of current in both primary and secondary coils. The fixed scale can take no account of such variations, no matter what their degree, and thus it becomes a measure of capacity only in name.

The attempt has been made by Von Ziemssmen and Edelmann to correct at least one of these faults, that is the variations in the inducing current. By introducing an adjustable resistance in circuit with the primary coil they have provided a means by which the resistance on the primary circuit may be made such as to adapt it to variations in strength in the primary battery and so keep the strength of the inducing current constant (*i. e.* 300 ma). With the inducing current constant it is assumed that the inducing effect upon the magnet and upon the windings of the secondary coil will be correspondingly constant. The scale accompanying instruments of this construction presumes to be graduated in volts. The accuracy of the calculation by which such a scale of volts is determined in the first instance is open to question. But assuming it is correct, this can only remain true for a fixed resistance between the terminals of the secondary coil, when the fact is that this resistance is continually varying in practice where some part of a patient completes the circuit. The calculated voltage on the scale is consequently never, or seldom, the actual voltage on the circuit. The Edelmann "faradimeter," as this is termed, is, therefore, at the best, a cumbersome and expensive arrangement, and in order to secure from it even that degree of advantage that it is capable of giving as a measurement of voltage the coils of all instruments must have identical construction or each must have a scale especially calculated for it.

The second method, by which attempts have been made to measure the current delivered by the coil, is by graduating a high-resistance rheostat placed in series with the coil and with the patient. Here the amount of current is shown by a scale indicating the quantity of resistance that is put in or taken out of the circuit. In other words, this, which may be termed the Monell method, attempts to measure the current in terms of ohms where the Edelman method seeks to express it in terms of volts. It is readily seen that this method also requires constancy in the inducing current in order that the scale may represent the same values at succeeding applications of the current, for a variation in the inducing force would be followed by a variation in the voltage and strength of the induced currents, and this variation the fixed scale on the rheostat does not record.

It is quite as essential also, in any attempt to make use of a high resistance rheostat as a faradimeter, that the coils used in all instruments should exactly correspond in structure, or that the scale used should be calibrated for each coil. I am not aware that either this or the constancy of the inducing current has been taken account of by the Monell method. Of course it is presumed that in this method the resistance of the material used in the construction of the rheostat does not change.

Neither the Edelmann nor the Monell method of measurement, even assuming that they are developed to their highest efficiency, are independent of the sensations of the patient for determining the dose of the coil current. Should the current, by chance, be applied to a limb or a part of the body in which both sensation and motion are impaired there would be no positive evidence given by either of these forms of so-called meters

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that a current is actually passing. In reality, therefore, the sensory or motor nerves are the parts in the circuit that actually determine the strength of current when either of these methods is used. It is my belief that until inventive ingenuity has been able to devise an instrument which can be placed directly in the patient's circuit of the induction coil current and record either the milliamperes or the electro-motive force of that current no satisfactory faradimeter will be forthcoming.

DISINTEGRATION OF TISSUE.

Physiological Effects of High Tension Discharges on Organic Structure.

The cases in which electricity has been applied successfully to the treatment and cure of disease, are by no means so numerous as we should expect. Among the many applications that have been attempted in this direction, few seem more promising than the destruction of malignant tumors by the electric discharge, so as to dispense altogether with the use of the surgeon's knife. This end does not appear yet to have been attained, but the series of interesting experiments on this subject recently made by Dr. J. Inglis Parsons* shows that considerable progress has been made in this direction. Dr. Parson's opinion, after several years' experience, is "that the role of electricity as a method of treatment, except for small ulcers, is to follow after excision, when nothing more can be done by the knife, and recurrence has occurred."

The important discovery which Dr. Parsons describes in this paper is that organic tissue can be disintegrated throughout the path of a current without appreciable heat or caustic action by the use of discharges from an induction coil. In 1888 he found that the effect of a constant current applied to fibroid tumors was confined to a small area around the poles, and that the destruction within the area was greater than was necessary. It appeared to him, therefore, more hopeful to endeavor to utilize the disruptive effect of a sudden discharge, and with this view the effect was tried of suddenly applying the current of a powerful voltaic battery. The success was only partial, and his experience thus far led him to think that the discharge from a powerful induction coil, with the lowest possible resistance in the secondary coil, would probably be the most effective for his purpose. The coil used in these experiments was made with the break to be worked by hand, and with a resistance in the secondary of only one-seventh that of the ordinary coil giving the same spark length. Dr. Parson's object in reducing the resistance of the secondary coil from 7,000 ohms to 1,000 ohms was to concentrate in the tumor a larger proportion of the total electric energy developed in the secondary circuit. The resistance of a tumor being from 100 to 250 ohms, very little of the total energy developed in a secondary circuit of 7,000 ohms would be developed in the tissue.

Dr. Parson's experiments were made by inserting platinum electrodes into pieces of beef, sections of which were examined under the microscope before and after the discharge from the coil. These sections showed that stripped muscular fibre could be completely disintegrated throughout the ellipsoidal space between the two poles. It was observed that the destruction was not quite so complete in the axis of the ellipsoid as nearer the surface. This curious effect, we should think, is due to the well-known tendency of rapidly varying currents to fly to the circumference of conductors. Another interesting outcome of these experiments was that, within certain limits, the effects of successive discharges were cumulative; if a discharge were too weak to produce disintegration with one application, success followed repeated applications of the same discharge.

Dr. Parsons thinks that pressure is of more importance than current in obtaining these disintegration effects. In that case, it is difficult to see why the reduction of the resistance of the secondary coil should be advantageous. It is difficult from the meagre data given in Dr. Parson's paper to determine the exact electrical conditions to which the organic tissue was subjected. A reduction of the resistance of the secondary coil would retard the rise of the current in it, and consequently would not subject the organic tissue to so great a difference of potential as a secondary of higher resistance. An experiment made by Dr. Parsons with a Leyden jar in circuit seems to support this view; here the increase of current was still more rapid, and the disintegration was found to be excessive, though it was confined almost completely to the line joining the poles. We congratulate Dr. Parsons on the success of his experiments, though we consider that more precise measurements are necessary to determine the exact electrical conditions as to current and pressure which are best adapted to produce the most favorable results.

*Trans. Obstetrical Soc. of Lond., V. 37.

DIRECT CURRENT IN PHONIC SPASM.

The last number of the *Lancet* contains a note by Mr. R. A. D. Daniel, M.B., formerly assistant physician at the Margaret-street Infirmary, on a case of phonic spasm successfully treated by electricity. The patient was twenty-five years of age, and had suffered from the complaint for over a year. It had come on gradually, and the patient described the effort to speak as being most distressing, as, though articulation proceeded, he was unable to produce any sound for an interval varying from one to two minutes. Examined with the laryngoscope nothing could be seen wrong with the vocal chords. "Under such circumstances," says Mr. Daniel, "I decided to call in the aid of electricity, and to this end used the constant current for from fifteen to twenty minutes every day for a fortnight, after which time, as progress was favorable, I reduced it to three times weekly. I employed sponge electrodes of such a size and shape as could conveniently be placed on either side of the larynx, and also varied the treatment on each occasion by directing the current antero-posteriorly, placing the anodal electrode over the larynx and the cathodal one on the back of the neck. The strength of the current used varied from two to three milliamperes, and the case was treated for nearly six weeks, improvement becoming more and more apparent. It ended happily in the disappearance of the patient's malady, of which two months afterwards there had been no return." The affection described occurs so rarely that it may be mentioned that in "phonic spasm" it is the nerves governing the larynx that refuse to act, whereas in the ordinary cases of stammering it is the mechanism of articulation that is defective. There is, however, a considerable analogy between the two, and the successful treatment of the laryngeal spasm may point out a method of attacking the commoner forms of defective articulation.

ELECTRIC POWER PAPER MILL.

The Cliff Paper Company, of Niagara Falls, are building a new power house, in which they will generate electricity for use in their paper mill. This paper company has a pulp mill, driven by two Leffel wheels, of 2,500 horse power, at the water's edge below the Falls, and a paper mill on the top of the high cliff, thus securing a double service from the water. This double use of water is quite an innovation, and has brought discredit upon the saying that "The mill will never grind with the water that is passed." Now, this progressive company is about to take another step to practice economy, and it will adopt electricity, to succeed steam, to run their paper machines. When this proposed electric plant is installed, it will drive out three steam engines of over 200 horse power. Preparatory to the adoption of the electric current, this company will build a stone powerhouse, 20x30 feet in size, close to their pulp mill. The penstock, leading to the pulp mill, will be tapped, and a portion of the water diverted to run a 250 horse power James Leffel turbine, to which will be attached two 125 horse power generators. The head of water on this turbine will be 125 feet. At the top of the cliff will be two electric motors, of 100 horse power each, attached to each of the paper machines; besides, there will be two motors of five horse power each, to furnish power for the small machinery about the mill.

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CARL FRIEDERICH GAUSS.

Born Apr. 23, 1777. Died 1855. Eminent German Mathematician. Director of Göttingen Observatory. In Association with Weber Made the First Observations on the Earth's Magnetism. Also in Connection with Weber Invented the Declination Needle and Bifilar Magnetometer.

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The Electrical Journal.

Vol. 1. CHICAGO, MARCH 15, 1896. No. 20

DYNAMO PLANT FOR TELEGRAPH

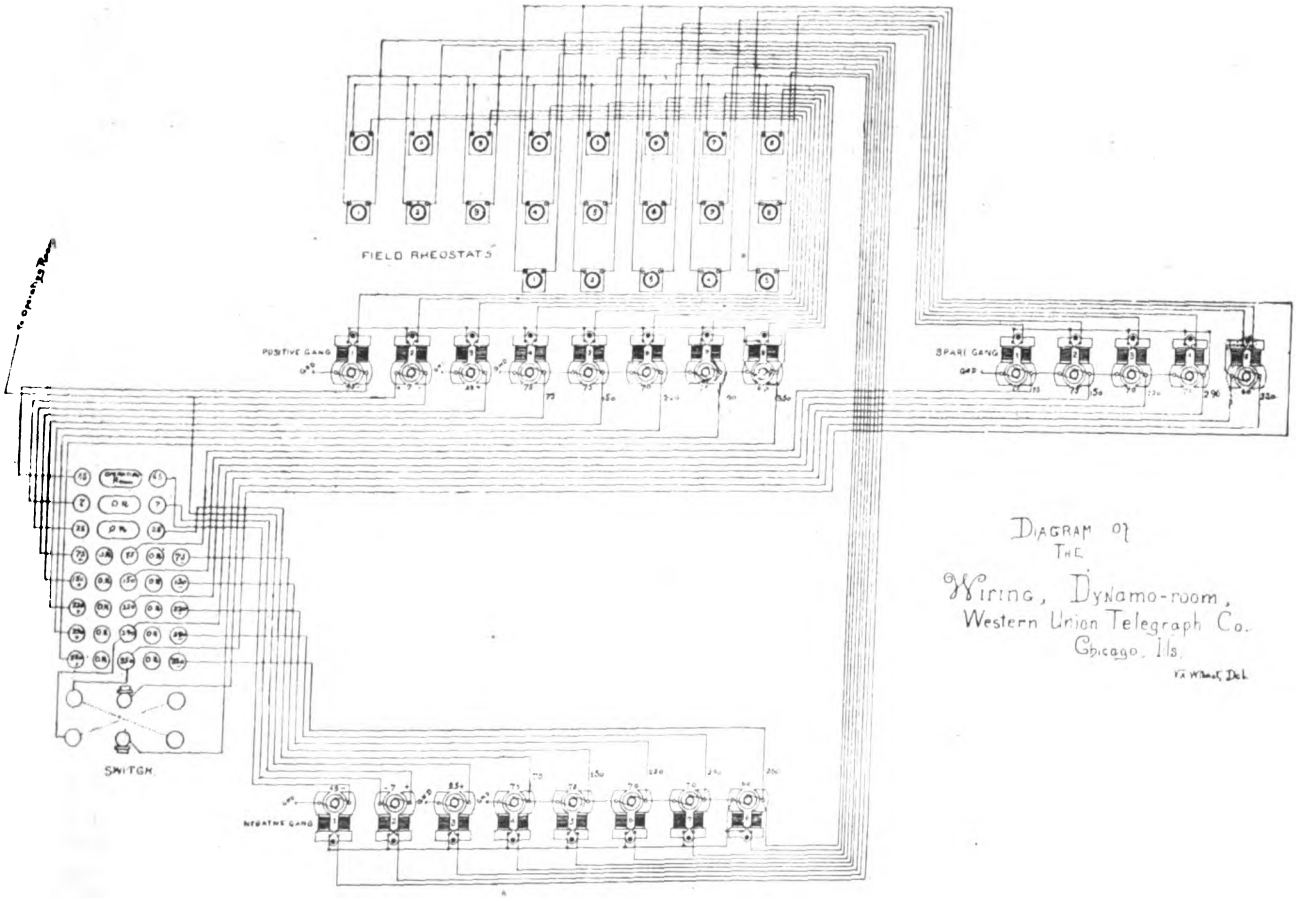
The Generator Plant of the Western Union Telegraph Company in Chicago Replaces Sixty Thousand Gravity Cells.

SOME VERY FLEXIBLE AND NOVEL FEATURES.

The Western Union Telegraph Company has installed in the basement of the Western Union Building a remarkably flexible and complete system of dynamos for supplying current to the numerous lines radiating from its office. The plant consists of three main batteries of dynamos, nineteen of which are Edison No. 2 machines of a rated capacity of 110 volts and 40 amperes: two Crocker-Wheeler generators of the same capacity are also used, being machines No. 1 in the positive and negative gangs. (See Fig. 1.) In addition are used 25 Crocker-Wheeler one-sixth H. P. 85 volt generators the use of which will be subsequently referred to. Three New York Safety engines of 20 H. P. each furnish the motive power, and in case of accidents, Sprague motors, deriving current from the mains of the Chicago Edison Company, can be instantly substituted for steam power. Two of these motors are of 15 H. P. each, the other one being rated at 10 H. P. Fig. 1 shows the general arrangement of the plant. The positive and negative gangs each consist of eight generators and the spare gang of five machines. The positive gang may, however, be run as the negative gang and vice versa, while the spare gang can be used either positively or negatively and these interchanges are made daily.

With the positive and negative gangs in operation the first three machines on one side only are used. Taking the machines in their numerical order, No. 1, of 45 volts potential is used to supply all pony wires within the city limits; No. 2, 7 volts, is used entirely in the office for energizing single wire sounders; No. 3, 23 volts, energizes the sounders of all multiplex instruments; Nos 4, 5, 6, 7, and 8 are connected up almost on the principle of the Siemens and Halske multi-wire system, except that one side of the system is grounded. (Fig. 2.) These five machines, which are duplicated by the five in the spare gang must be run in sets of two, positive and negative. Nos 4 and 5 are used to work single and multiplex circuits for short distances. Nos. 6, 7 and 8 are used entirely for multiplex circuits, the voltage increasing with the distance and the resistance.

The supplementary battery of 25 small Crocker-Wheeler machines, is in constant operation, any one of which, may from the switchboard in the office, be thrown into any circuit in lieu of an automatic repeater. For instance, Toledo might call up



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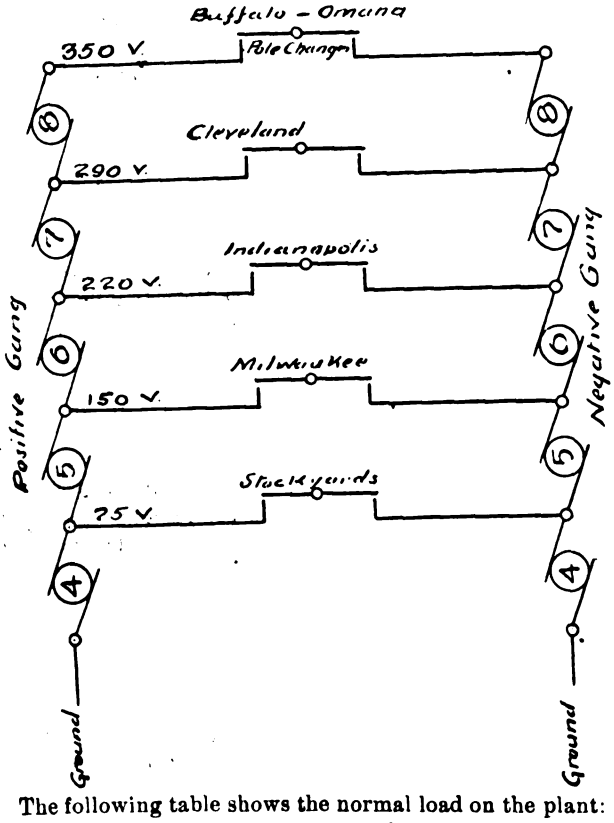
Milwaukee and by the insertion of a plug in the switch board one of these small generators is thrown into the circuit augmenting the voltage, doing away with the set of automatic repeaters which, otherwise, would have to be used.

A peculiar feature of the entire plant is that only one generator (No. 8) in each gang is self-exciting and part of its current excites the fields of all the other machines in the gang, through suitable rheostats, and in this way the voltage of each machine is maintained at the figures as shown in Fig. 1, although all the machines are normally rated at 110 volts. In addition to this, dynamo No. 4 of the positive gang then in operation, energizes the fields of the entire battery of 25 small Crocker-Wheeler generators none of which are self exciting.



The following table shows the normal load on the plant:

No. 1	45 volts	11 amperes	
2	7 "	22 "	
3	23 "	44 "	
4	75 "	3 "	to line
		3 "	exciter.
5	75 "	2.1 "	
6	70 "	1.25 "	
7	70 "	2.25 "	
8	60 "	3 "	to line
		9 "	exciter

The plan of doing away with self-exciting fields enables the operator to maintain the voltage within very narrow limits and as the total load fluctuates very little a minimum of supervision is needed.

Lines from this office are worked as far east as Buffalo and Pittsburg, in the west to Sioux City, Omaha, and Kansas City, and in the south to Memphis, Tenn., in other words within a radius of about 500 miles; beyond this radius automatic repeaters must be used for points outside.

This dynamo plant replaces a gravity battery equipment of about 60,000 cells, which number could scarcely be closely packed in twice the space occupied by the modern installation, to say nothing of the expense and labor involved in the maintenance of that vast number of primary batteries.

Mr. John F. Green, of Baltimore, has discovered a process, so he claims, for separating pure asbestos fibre from foreign matter, and for making it into sheets for electric insulation purposes. It has the advantages of being an excellent insulator and of withstanding heat also.

SPECIFICATIONS FOR LAMP POSTS.

Simple, Plain and Complete Directions for Bidders to Be Guided By In Figuring on Work.

The following specifications are published, because of their completeness and the concise manner of directing bidders who desire all possible information before going into the question of the cost of material asked for. These specifications were drawn by Mr. Foree Bain, Engineer to the Chicago West Park Board, for the supply of 1,000 arc lamp posts for the use of the board on the boulevards and in the parks. The awards have been made and the work begun.

SPECIFICATIONS.

SPECIFICATIONS FOR ELECTRIC POLES FOR SUPPORTING THE LAMPS USED FOR ILLUMINATING THE PARKS AND BOULEVARDS UNDER THE SUPERVISION OF THE WEST CHICAGO PARK COMMISSIONERS.

The plans, drawings and dimensions of the Lamp Poles, which are on file at the office of the West Chicago Park Commissioners, at Union Park, and at the office of their Engineer. Foree Bain, Suite No. 1657-8 and 9, Monadnock Blk., form part of this specification.

The pole is made in three sections, the lower section being entirely of cast iron, the upper section being cast iron with a galvanized iron pipe cast integral therewith, and the center, or intermediate section being made of wood subjected to a special process.

Bids will be received under three sections of these specifications, viz: "Section A," specifying the iron portions. "Section B" specifying the wood portion. "Section C," specifying the switches.

Any one contractor may bid under either or all sections, in which event the bids must be enclosed in separate envelopes and endorsed, "Section A, Lamp Poles." "Section B, Lamp Poles." "Section C, Lamp Poles."

Contractors may bid separately upon the lower and the upper portion of the pole, or on both, giving price per pound and also price per piece.

SECTION A.

The lower portion of the Lamp Pole is eleven (11) feet extreme dimensions, five feet of which is intended to be placed under ground, six feet of which is intended to be above the surface to receive the wooden section, as shown in the drawings.

The castings must present a clean, smooth appearance, free from blow holes, and must not be of a spongy character. They must be of a close, even grain and made of the best quality of material that can be used for the purpose of strength and uniform weight.

The castings must be brushed smooth, free from sand and must be painted, as soon after being cast as possible, with a coat of genuine boiled linseed oil.

The core must be central so that the castings will not be thicker on one side than the other.

The sockets must be uniform in size so that the wooden pole will rest properly in a perpendicular position therein.

The castings must not show any inequality at the parting, or any cracks or flaws of any nature.

The lower portion, or casting, must weigh within 5 per cent. of 1,000 pounds. There must not be a greater variation than 5 per cent. from the weight given in any castings furnished for this purpose.

The Engineer will inspect the castings at the foundry of the Contractor, for his convenience, and the Contractor must readily afford him all assistance necessary for said inspection, such as handling the castings for the purpose of examination and for the purpose of weighing. But if the foundry is not within the city limits transportation must be furnished for the Engineer.

Any casting which is found not to be in strict accordance with these specifications is to be mutilated and rejected.

The lower Section must be provided with a door, as shown in the drawings. The door must have securely attached to it a good Yale Lock. All of the said locks adapted to be

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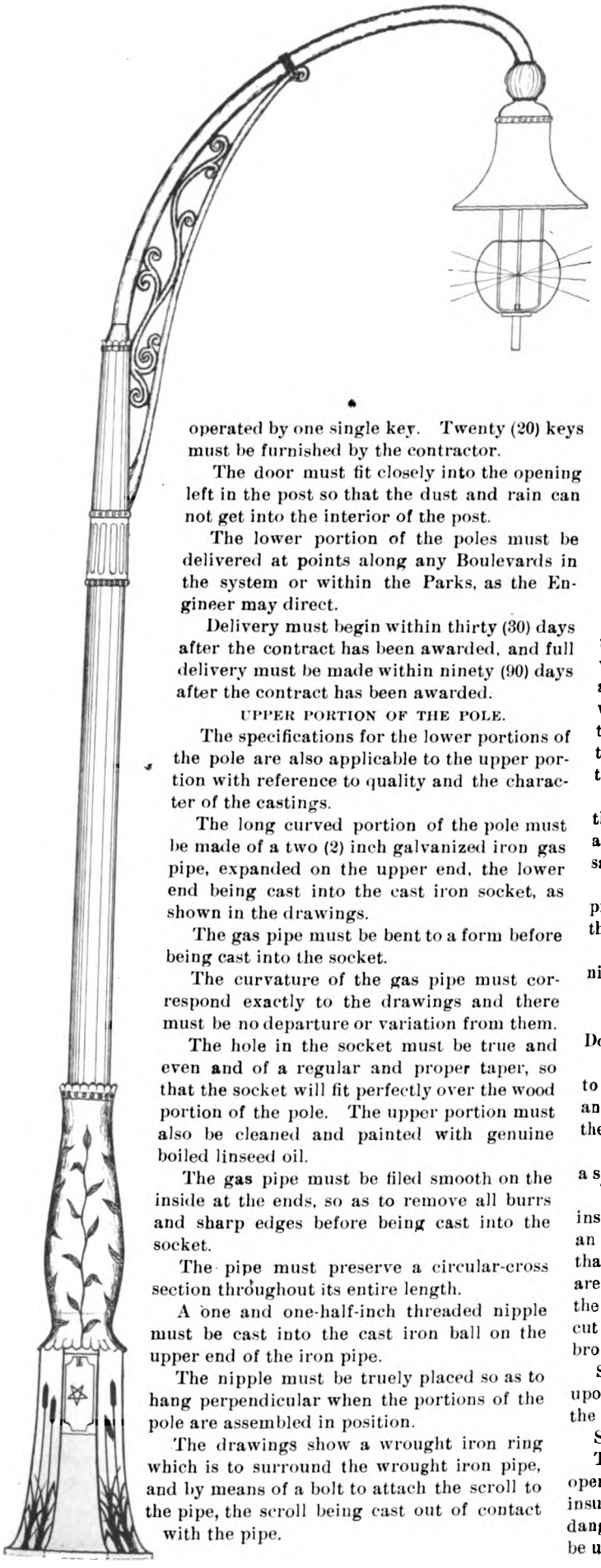

operated by one single key. Twenty (20) keys must be furnished by the contractor.

The door must fit closely into the opening left in the post so that the dust and rain can not get into the interior of the post.

The lower portion of the poles must be delivered at points along any Boulevards in the system or within the Parks, as the Engineer may direct.

Delivery must begin within thirty (30) days after the contract has been awarded, and full delivery must be made within ninety (90) days after the contract has been awarded.

UPPER PORTION OF THE POLE.

The specifications for the lower portions of the pole are also applicable to the upper portion with reference to quality and the character of the castings.

The long curved portion of the pole must be made of a two (2) inch galvanized iron gas pipe, expanded on the upper end, the lower end being cast into the cast iron socket, as shown in the drawings.

The gas pipe must be bent to a form before being cast into the socket.

The curvature of the gas pipe must correspond exactly to the drawings and there must be no departure or variation from them.

The hole in the socket must be true and even and of a regular and proper taper, so that the socket will fit perfectly over the wood portion of the pole. The upper portion must also be cleaned and painted with genuine boiled linseed oil.

The gas pipe must be filed smooth on the inside at the ends, so as to remove all burrs and sharp edges before being cast into the socket.

The pipe must preserve a circular-cross section throughout its entire length.

A one and one-half-inch threaded nipple must be cast into the cast iron ball on the upper end of the iron pipe.

The nipple must be truely placed so as to hang perpendicular when the portions of the pole are assembled in position.

The drawings show a wrought iron ring which is to surround the wrought iron pipe, and by means of a bolt to attach the scroll to the pipe, the scroll being cast out of contact with the pipe.

The upper cast iron portion must be furnished complete ready to be placed in position.

Each contractor must figure to furnish his own patterns.

The upper portion, when complete, must weigh within 5 per cent of 170 pounds, and there must not be a greater variation than 5 per cent from the weight given.

The upper portion of the casting referred to must be delivered within four months, dating from the awarding of the contract.

There will be 1,000, more or less, poles complete.

The contractor may bid on the iron portions under this section in lots of one hundred or more.

Bids will be accepted for the iron portion of the pole under this section and in accordance with these specifications complete, for each piece, and the price per pound will also be received for the number specified, more or less.

Any sections showing flaws or defects, or not coming within the true spirit and intent of these specifications, are to be rejected and deducted from the credit of the contractor furnishing the same.

SECTION B.

There will be required about 1,000 wooden sections, more or less.

The wooden sections shown in the drawings must be made of clear, straight-grained Georgia pine or Norway pine, free from knots, wind shakes or other imperfections.

A round hole 1¼ inches in diameter must be bored through the center of the wood section from end to end.

The wood section must be turned up round and smooth and to size, as shown in the drawings, and must be properly treated with creosote or other acceptable wood preservative, by having all of the sap and other liquids extracted and the grain filled with preservative mixture to such an extent that when sawing through the wood section at any point it may be shown that the said preservative has penetrated and completely saturated the wood.

Any section showing flaws or defects or not coming within the true spirit and intent of these specifications is to be rejected and deducted from the credit of the contractor furnishing the same.

Prices per piece, as shown in drawing, must be given, also price per foot for each additional foot, eighteen (18) feet being the maximum length required.

The wood sections must be delivered at Garfield Park within ninety (90) days after the contract has been awarded.

SECTION C. SWITCHES.

There will be required one thousand (1,000) Double Pole Double Throw Switches, (more or less.)

The switches are designed to be placed within the poles and to cut free from the main circuit both terminals of the lamp, and to close the main circuit while the lamp is removed from the main circuit.

The switch is to be placed within the cavity of the pole within a space not to exceed eight (8) inches square.

The switch must be of good mechanical design capable of insulating 6,000 volts from the ground, adapted to operate with an automatic spring-snap movement, and it must be so arranged that the lamp is short-circuited before the terminals of the lamp are open-circuited so as to prevent sparking at the terminals of the switches, and it must also be arranged so that the lamp is cut into circuit before the short-circuit of the cable terminals is broken.

Samples of the switches, with explanations and comments upon their qualities and adaptability must be submitted with the bids.

Switches costing more than $2.00 each will not be considered.

The handle, or key, attached to the switch for the purpose of operating it, must be made of hard rubber, or an equally good insulator of sufficient length so as to protect the operator against danger from the high potential circuit on which the switch is to be used.

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The switches are designed to be placed in circuits having a potential difference of 6,000 volts, with a potential difference of 50 volts at the lamp which they are to control.

Switches under this section must be delivered within ninety (90) days from the date of awarding the contract.

Prices mentioned must include delivery at Garfield Park.

IN GENERAL.

The contractor must furnish bond from a Surety Company, doing business in the City of Chicago, and acceptable to the West Chicago Park Commissioners, guaranteeing the faithful performance of the contract in accordance with these specifications, and within the time hereinbefore specified.

The sum of one per cent (1%) of the total contract price is to be deducted for each and every day the work remains unfinished after the period named herein for its completion.

Payments will be made in cash as the work progresses within 25 per cent of the estimates of the engineer.

Proposals must be made out on the blank forms to be obtained at the office of the West Chicago Park Commissioners, in Union Park, and addressed to the West Chicago Park Commissioners, and endorsed as hereinbefore specified, and must be accompanied with 5 per cent of the amount of the proposal in currency, or a certified check for the same amount drawn on a responsible bank doing business in the city of Chicago and made payable to the order of the West Chicago Park Commissioners.

The West Chicago Park Commissioners reserve the right to reject any and all bids.

Bids will be opened Tuesday, February 11th, 1896, at 4 o'clock P. M., at the office of the West Chicago Park Commissioners.

Office of Foree Bain, electrical and mechanical engineer, suite No. 1657-8 & 9 Monadnock block.

Chicago, Ill., January 24, 1896.

ELECTRIC PUMPING STATION.

An interesting example of the facility with which electricity lends itself to the transmission of power will shortly be seen on the premises of Smith's Dock Company, South Shields.

There is at present there a floating dock, upon which are located engines and pumps for the purpose of pumping out the water when it is desired to float a vessel. The boilers which supply the steam are, however, on the shore, the connection being made by flexible steam pipes in a somewhat cumbersome and unsatisfactory manner. A new dock of the same type will shortly be installed, but in this case the power is to be transmitted from the shore by electric conductors. On the dock there will be erected eight 18-inch centrifugal pumps, each driven by an independent motor of 60 brake-horse-power. The fan of the pump and the armature of the corresponding electric motor will be on the same vertical shaft, extending from the deck to the bottom of the floating structure, the weight being carried on ball bearings. The speed of rotation will be 385 revolutions per minute, and it is expected the plant will raise 16,000 tons of water per hour against a mean head of 18 feet. If this will be realized, it will he possible to raise the dock with a ship of the largest tonnage in about half an hour. The generating plant will be fixed on shore at a distance of about 200 yards from the dock, and will comprise two sets of direct-coupled engines and dynamos capable of supplying 850 amperes at 500 volts. This current will be transmitted through Fowler-Waring armored cables to a cabin on the deck, from whence a single attendant will be able to, by means of switches and regulating rheostats, to control all the motors.—*London Engineering.*

ANOTHER WESTINGHOUSE ELECTRIC ENGINE.

Another electric locomotive of the Baldwin-Westinghouse type will soon be sent from Philadelphia to Wilmerding to be fitted up with the Westinghouse motors. The new machine is for the Crozier Iron Company, of Virgina, and will be used in the mines, for ordinary locomotives are considered dangerous. It is thought that electric engines will prove more efficient than compressed air locomatives for mining purposes.

AMERICAN INSTITUTE—NEW MEMBERS.

At the meeting of the Institute February 26, the report of the Committee on Incorporation was read, and a resolution empowering the Council to proceed with the work of Incorporation was unanimously adopted.

The discussion of Mr. Sprague's paper on Electric Elevators was then taken up in accordance with a vote of the meeting of January 22, when lack of time prevented some members from participating. The discussion was re-opened by Dr. Hutchison who presented the results of actual tests made. He was followed by Messrs. Geo. Hill, R. P. Bolton, H. Ward Leonard and others.

At the meeting of Council in the afternoon the following Associate Members were elected :

Daniel Adamson, Hyde, England.
Isaac F. Badeau, 213 W. 121st Street, New York City.
Samuel D. Collett, 15 Cranberry Street, Brooklyn, N. Y.
Edward P. Decker, Van Pelt Manor, S. I.
Samuel L. Foster, 839 24th Street, San Francisco, Cal.
Eugene E. Griffees, 307 South Main Street, Los Angeles, Cal.
Ralph L. Montague, Bannock, Mont.
Edwin S. Reid, *Times* Building New York City.
E. C Sharpe, Potomac Block, Los Angeles, Cal.
Edward Sullivan, 108 Fulton Street, New York City.

The following Associate Members were transferred to Full Membership upon recommendation of the Board of Examiners:

Geo. D. Shepardson, Minneapolis, Minn.
Henry A. Sinclair, The Tucker Electric Company, New York City.
Paul N. Munn, Telluride, Colo.
Geo. H. Winslow, Lewis Block, Pittsburg, Pa.
Wm. D. Gharky, Philadelphia Traction Company, Philadelphia, Pa.
Walter C. Fish, General Electric Company, Lynn, Mass.

USEFUL WORK FOR THE BICYCLE.

Among recent developments to which the widespread use of the bicycle has led, says the Indianapolis *Sentinel*, is a machine for enabling the cyclist to train or take his exercise indoors in bad weather. The rider sits on the saddle and works the pedals in the usual way, and while the wheels revolve, their force is expended on the turning of an endless belt, and the bicycle never moves from the spot. It has occurred to a French electrician that some useful work can be done at the same time. He has accordingly designed an apparatus, in which the driving wheel of a safety bicycle of the usual type is raised from the floor, and by means of a strap and speed-gearing, made to drive a small dynamo, which is used to charge accumulators.

This idea of turning exercise into a useful product outside of its own special purpose is capable of wide application. One instance of it will readily be remembered. Nansen, in fitting out the Fram for his Arctic expedition, had a capstan placed on deck, the shaft of which was connected by gearing with the ship's dynamo.

The object of this was, that, in the long dark winter of the polar regions, the crew should daily take the exercise needed for health, by doing their shift at the capstan, and at the same time generate the electricity needed for lighting the ship. In some English prisons, where the energy derived from the working of the treadmill by the convicts has hitherto been insufficiently utilized, it is now proposed to turn it to the generation of electricity for lighting the buildings, making the prison industries more remunerative and giving the prisoners a training which will enable them to live honestly when they are discharged.

Russia is to have an electrical branch of her army under the direction of a lieutenant general, two major generals and five officers of lower grade; who will also have a military electrical school under their charge. Russian military officers have always been very adept in the use of electricity.

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USE OF GARBAGE CREMATORIES.*

Their Value As Producers of Electric Energy and as Auxiliaries to Central Stations in Taking Part of the Load at Odd Hours.

VARIOUS METHODS OF THEIR APPLICATION.

Since the publication of Mr. Charles Jones' book on "Refuse Destructors," a great deal of thought has been bestowed on the question of the incineration of refuse, not only on account of the great value possessed by this sanitary method of garbage disposal, but because of the economic possibilities that attend the utilization of the calorific value of garbage as fuel. From the fifty destructors mentioned by Mr. Jones, consuming daily from three and one-half to ten tons of garbage, there is obtained on an average from five to seven horse-power per cell.

Up to within a year or so the steam-raising powers of these crematories were utilized only in connection with such industries as stone-breakers and mortar mills; or as subsidiary to electric-lighting stations to carry the day load.

It ought to be stated at the outset that garbage crematories as steam-raisers have a very limited range. From the nature of the material burned one would rightly surmise that its calorific value as fuel would be small. A large percentage of the weight of refuse is moisture, in expelling which considerable heat is lost. Then again the presence of non-carbonaceous matter, as ash-bin refuse, detracts from the calorific value. So that while crematories running on this fuel may be counted on to furnish a certain amount of power continuously, they are not susceptible of being "driven" unless additional fuel is burned on the grates. This explains the circumstance, that up to the present, garbage crematories have only been used under conditions where the load has been comparatively uniform during the entire day, as in the instances mentioned above.

In an interesting paper read before the Northern Society of Electrical Engineers, Manchester, England, December 10, 1894, Mr. Albert H. Gibbings emphasized the value of some method of storage in connection with power plants deriving their energy from garbage furnaces. The special form of storage advocated by Mr. Gibbings was that of accumulators, and he proposed using the stored up energy for tramcar traction. At that time the corporation of Hull was running an electric-light station, the profits of which, so far as the day load was concerned, were very small. Mr. Gibbings showed that if garbage crematories then operated by the same municipality should be used in connection with a low-tension electric plant to charge accumulators for traction purposes, and the main lighting plant be utilized during the daytime to augment the output of the former, not only would the crematories be revenue-producing, but a handsome profit would result from the day load of the lighting plant. Apart, however, from the question of profits, emphasis was laid upon the necessity of some method of storage which would give to crematories the ability to respond to a wider demand for power than they have been capable up to that time.

The idea has been very completely carried out by the vestry of St. Leonard, Shoreditch, in London. As far back as 1892 the vestry had in view the erection of a central electric-lighting station and a garbage crematory. Upon the advice of their engineer the two plants were combined. In order to have sufficient power to tide the lighting plant over the hours of heavy load, it was decided to adopt the patented thermal storage system of Mr. Druitt Halpin. From a paper read last year before the Hull Congress of the British Institute of Public Health it is learned that the storage system consists of seven reservoirs, each thirty-five feet in length and eight feet in diameter. These are connected to the boilers and accumulate the energy developed but not used during those portions of the day when the number of lights in service is comparatively small.

* By Maurice Barnett in The Manufacturers' Record.

What is of great interest and importance is the fact that this combined plant of garbage crematories and storage system is being installed by a firm of standing, under a guarantee—in which there are heavy penalties for failure—that the apparatus in question will produce 100,000 pounds of steam in twenty-four hours by the combustion of the refuse without the use of coal or additional fuel.

Considering now that England has at the present time over 100 "destructors" at work, many of which are furnishing power for industrial establishments at a cost considerably less than the same power would cost if obtained from coal, it is pertinent to inquire what Americans have been doing in this line.

The writer having looked carefully over the files of the engineering journals, and having made inquiries at the offices of companies engaged in erecting garbage furnaces, cannot find a single instance in this country where the calorific value of garbage as fuel has been utilized for steam-raising purposes.

Some explanation of this is afforded by a peculiar impression existing on this side of the Atlantic. In the prospectus of the Eagle Sanitary & Cremation Co., this statement is made—that ash-bin waste here "does not contain so large a proportion of combustible matter because of the greater amount of clinkers and slate remaining from the imperfect combustion of anthracite coal, which produces a coarser ash and far less burnable residum than does the soft bituminous English coal." While this is true, the statement has force only in localities where anthracite coal is used. Statistics taken from the *Mineral Industry* show that in 1894 the production of bituminous coal in the United States was 118,000,000 tons, as against 52,000,000 tons of anthracite coal, so that there is left quite a large area where the conditions are as favorable as in England for the utilization of ash-bin refuse as fuel.

It would seem, with "destructors" in successful operation abroad, with conditions as favorable here as elsewhere, with many municipalities owning their own electric-lighting plants, and lastly, with a strong popular feeling in favor of the sanitary combustion of refuse, as if there were strong reasons why this matter of crematories, operated in conjunction with industrial lighting plants, should be taken up here as it has been in England. It was with surprise that the writer learned that there were no such combined plants here, and could only explain this on the assumption that sanitary cremation companies were not fully alive to what was accomplished with different forms of storage apparatus.

Of the various forms of storage, as steam storage, feed storage, combined feed and steam storage and storage batteries, the last, both on theoretical and practical grounds, would seem to be the best, "because of its forming the last link in the chain, thereby giving the economies of continuous working to all that precede." The basis for this statement is the fact that storage batteries are cheaper in first cost than the equivalent steam-power plant which they would replace, have a wider range of power and are more economical in operation than other forms of storage apparatus.

It is to be hoped that municipalities having, or contemplating, the establishment of their own lighting plants will seriously consider the question of combining their lighting station with some well-equipped garbage crematoreis supplied with efficient storage apparatus. Besides having a sanitary method of disposing of their refuse, they would find that their lighting plant could be operated cheaper than without the crematory adjunct, while the storage apparatus, besides enabling them to use the heat going to waste the greater part of the day and night, when there is not a large demand for power, would give a wide range of power to the lighting station, enabling it to respond to the fluctuations of load incidental to electric lighting and save the generating machinery from the strains to which it would otherwise be subject.

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A MODEL ISOLATED PLANT.*

The Electrical Plant at the United States Public Printing Office, in Washington, has a Capacity of 427 K. W.

SPLENDID SWITCH-BOARD ARRANGEMENTS.

The plant consists of one 187½-kilowatt direct connected generator and three 80-kilowatt belted generators, all of the most improved compound multipolar Westinghouse type. The 187½-kilowatt generator is directly connected with a Westinghouse compound condensing engine of 250 H. P. The two machines occupy a floor space of 21ft. by 7½ft. The 80-kilowatt generators are driven from a line shaft which is belted to a 250 H. P. compound condensing engine of the marine type. Friction clutch pulleys are used for driving these generators, thus giving the greatest flexibility to the plant by allowing the stopping of any one of the three generators while the others are in use. These, independent of the direct-connected generator, are capable of furnishing all the necessary power as well as light needed in the office in case a total breakdown of the direct-connected unit occurs. The total capacity of the four generators is 8,500,50-watt 16 c. p. incandescent lamps—more than sufficient for all lighting and power demands.

The peculiarities of the work of the office make necessary a sectional rather then a general system of electric lighting. With this end in view, the wiring has been done entirely on the "crib', system. This affords a uniform distribution of light throughout every division of the office, the rooms farthest away from the generator station being equally as well lighted as those near by. So perfect is this result that nowhere in the building does the variation from the switchboard to lamp exceed 2½ volts, nor is the varation in any one room ever more than one-fourth to one-half volt, no matter how many or how few lamps may be burning on the circuit. The capacity of all main trunk lines and feeders is so large that circuit regulators on the switchboard are not required.

To make up any loss from generator to lamp, the generators are overcompounded 1½ per cent., and their makers guarantee that no greater loss than 3 per cent. will occur from full to no load. Thus there will be a constant voltage at the lamps, whatever may be the existing conditions, insuring full candle-power and the long life of the lamps. We are thus able to get full benefit of the current generated, and not have a considerable portion of it consumed in rheostats that the system may be kept in balance.

The crib system has been extended to vertical mains as well, thus allowing the disconnecting of one side of the circuit without interrupting the service throughout that circuit while in use. The crib system of wiring not only increases the flexibility of the plant, but minimises the possibilities of interruption of work, and also equalises the distribution of current to the lighting mains.

In carrying out the instructions as to the application of electrical power, the office will use at present 70 Crocker-Wheeler electric motors of ⅛ H. P. to 3 H. P., aggregating 225 H. P.

To secure full protection against any possible interruption of work, except through a total failure of steam-power by accident, a suitable electrical switchboard of special design became necessary. This board is one of the largest and most complete in the country. It presents many peculiar features and fully meets the exactions of the service here which will not permit of interruptions during the sessions of Congress. The switchboard is divided into five panels—three for lighting and two for power. It is so constructed that an additional panel may be made without changing any of the connections. There are two sets of 'bus bars extending the entire length of the board, one for the use of the lighting circuits and the other for power circuits. By the use of a switch the two 'bus bars can be connected so as to make one continuous 'bus bar, and power and lighting circuits may be run together and from one generator should occasion therefor occur. Each generator is connected to the switchboard by a double-pole double-throw switch, thus allowing any generator to be used for power or lighting as occasion may require. Each feeder circuit is also controlled by a double-pole double-throw switch, giving every circuit throughout the building two sources of current and providing for an uninterrupted system either of light or power. Under normal conditions all lights will be run from one set of 'bus bars and the power circuits from the other, but when both power and lighting load becomes sufficiently small so that the combined demands of both are not in excess of the power of one 80-kilowatt generator, all work will be so divided by the switchboard as to make it possible to run everything from one generator. This board allows the changing from one generator to the other without any interruption to the service in the building or the running of the generators in multiple

Each panel is provided with a standard Weston volt and ammeter. Each power circuit is supplied with a round pattern Weston ammeter. There is also connected to the lighting service a recording voltmeter. For testing insulation of each circuit there is a special reading in ohms marked on one of the voltmeters, thus enabling a daily log to be kept of the condition of each circuit of the plant. The measuring will be done by drop-of-potential method, and not only will each individual circuit be tested, but each leg of each circuit, a suitable switch being provided for the purpose.

More than 20 miles of wires of the best kind are used in the circuits, and during its erection full use was made of every precaution known that would render property and life more safe

The insulation test of this entire system with all cut-outs in circuit will reach, under ordinary conditions, 8 megohms.

One of the special features of this electrical plant is the transmission of power by electricity. In all cases where it was possible so to do without interrupting work, we have connected motors direct to the machines themselves, doing away entirely with the use of belting and its attendant losses, disadvantages, and dangers. We find that the printing presses and some of the other large machines were never driven to their full capacity by belts, and that since they have been geared direct to the electric motors nearly double the amount of work has been done on some of them.

In gearing motors direct to printing presses we have not only secured the advantage of displacing belting, but enable the pressman, by the use of a reversing regulator, to have absolute controll of his press when making ready, and move the bed-plate forward or backward as desired, and without the help of a laborer. The speed of the press can also be regulated at will.

The two principal advantages of electric motive power over shafts and belts are the reduction of the friction load to a minimum and the independent working of each machine. Under the shaft-and-belt system the breaking of a belt often necessitated the shutting down of all the mechanical divisions.

To each motor is attached an automatic cut-off, so that accidents are not liable to occur through carelessness of employes. A still further safeguard is the automatic circuit-breaker, which prevents the overloading of motors.

In the erection of the plant every approved electrical device has been used. The short period during which the new plant has been in operation prevents full statements as to the amount of current and power consumed by each division of the office and the actual amount of power saved, as compared with the old system.

*Report by the Chief Electrician to the United States Public Printer.

The Welsbach lights used in lighting the streets of New Castle, Delaware, are proving unsatisfactory, and have been severely criticised in the council. The police claim that the lamps cannot be kept lighted.

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INSULATION RESISTANCE TEST.

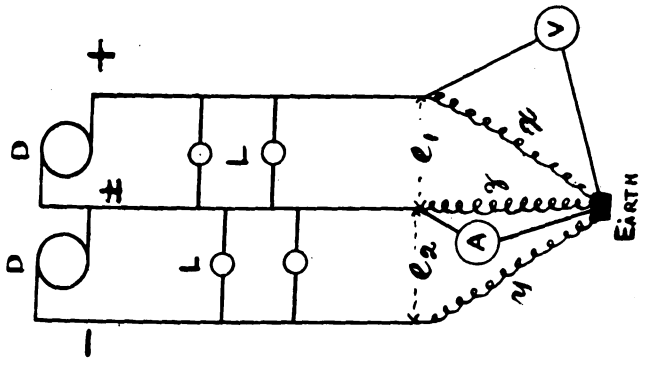
Method of Making Tests of The Insulation Resistances of a Three Wire System that is Equally Applicable to a Two Wire System.

SOME INTERESTING AND VALUABLE FORMULÆ.

In the JOURNAL of Dec. 1st 1895, Prof. Anthony showed that the insulation resistances of a three-wire system could not be determined by the voltmeter method while the dynamos were in operation. For it appeared that if the instruments were connected between earth and each main in succession and the readings taken, these values of voltage would not be wholly independent of each other. And if any two readings were taken, the third could be deduced from them.

The method turns out to be one which gives two equations between three unknown quantities and therefore the quantities cannot be determined.

A third equation independent of the other two may readily be obtained from which the unknown quantities can be found. Thus if the volmeter be connected in succession to the positive and to the negative mains. These readings will be independent of each other and two independent equations between the three unknown quantities may be obtained.



In order to obtain a third equation let an ammeter of negligible resistance be connected between earth and the neutral main. A current will, in general, flow and its amount will be the difference between those flowing through the ground resistances on the two sides of the circuit. For, since the ground on the neutral main is short-circuited by the ammeter, all the current that flows between the earth and the mains will pass through the ammeter.

The diagram represents two dynamos D. D. in series, feeding a three-wire system. L, L. are lamps or other translating devices. Three resistances are shown to represent the "grounds." Let x, y and z be the *conductivities* of these resistances between the earth and the positive, negative and neutral mains respectively.

Let e_1 be the potential difference between the positive main and the neutral, at the point where the observations are made and e_2 that between the negative and the neutral. V is one position of the voltmeter and A is the ammeter. Calling k the conductivity of the voltmeter and p the reading when joined between the positive side and earth, we have the equation

$$p\,k + p\,x = (e_1 - p)\,z + (e_1 + e_2 - p)\,y \ldots\ldots\ldots (1)$$

and when the voltmeter is joined from earth to the negative main we have calling the reading n.

$$n\,k + n\,y + (e_2 - n)\,z = (e_1 = e_2 - n)\,x \ldots\ldots\ldots (2)$$

The current through z being supposed to flow from earth to the neutral main when either observation is made.

Now let the ammeter be joined from earth to the neutral main. A current will flow, and, let its value be c. If this be taken as positive when the direction of flows is from earth to the main and negative when in the opposite direction we shall have the equation

$$e_1\,x - e_2\,y = c \ldots\ldots\ldots (3)$$

These three equations are independent and are sufficient to determine the values of x, y and z.

Solving them for these unknown quantities we have

$$x = \frac{[(e_1-p)\,n - (e_2-n)\,(e_1+e_2-p)]\,c - [(e_2-n)\,p + (e_1-p)\,n]\,k\,e_2}{e_1[(e_1-p)n-(e_2-n)(e_1+e_2-p)]+e_2[(e_2-n)p-(e_1-p)(e_1+e_2-n)]}$$

$$y = \frac{-[(e_2-n)\,p-(e_1-p)\,(e_1+e_2-n)]c-[(e_2-n)\,p+(e_1-p)\,n]\,k\,e_1}{e_1[(e_1-p)n-(e_2-n)(e_1+e_2-p)]+e_2[(e_2-n)p-(e_1-p)(e_1+e_2-n)]}$$

$$z = \frac{[p\,n-(e_1+e_2-p)\,(e_1+e_2-n)]\,c+p\,k\,[e_1\,n-e_2\,(e_1+e_2-n)]+n\,k}{e_1[(e_1-p)n-(e_2-n)(e_1+e_2-p)]+e_2[(e_2-n)p-(e_1-p)(e_1+e_2-n)]\,[e_1(e_1+e_2-p)-e_2p]}$$

Where $e_1 = e_2 = e$ the usual case in practice these equations become

$$X = \frac{c[e(n+p-2e)+2n(e-p)]-ke[e(p+n)-2pn]}{4e(e-p)(n-e)} \ldots\ldots\ldots (4)$$

$$Y = \frac{c[e(2e-n-p)-2p(e-n)]-ke[e(p+n)-2pn]}{4e(e-p)(n-e)} \ldots\ldots\ldots (5)$$

$$Z = \frac{ke(n-p)-c(2e-n-p)}{4e(e-p)(n-e)} \ldots\ldots\ldots (6)$$

Since these last equations give the conductivities of the ground resistances, the resistances themselves are obtained by taking the reciprocals of these values of x, y and z and substituting in them the observed values of e, p, n, k and c. If e, p and n are expressed in volts C in amperes and $1-k$ in ohms, the result will be in ohms.

Referring to equations (1) and (2), it will be seen that if z is zero that is, the neutral ground infinitely great, the term in each containing z drops out and the case corresponds to a two-wire system having a potential difference between the mains of $l_1 + l_2$ or e, say. It will be observed also that eq. (3) is not necessary, under this condition, for finding the values of x and y. Nor would it be practicable to connect an ammeter on a two-wire circuit in a way similar to that in which it could be used in the manner indicated above.

If equations (4), (5) and (6) be true for a three-wire system they ought to apply also to a two-wire system which is only a special case of a three-wire system, having a ground resistance on the neutral main infinitely great. In his case z eq. (6) becomes zero. On the value of c which makes z zero is

$$C = \frac{ke(n-p)}{2e-n-p}$$

This value substituted in (4) and (5) reduce x and y to

$$X = \frac{k\,n}{E-(p+n)}$$

and

$$Y = \frac{k\,p}{E-(n+p)}$$

Calling G+ and G− the ground resistances on the positive and the negative mains respectively and R the resistance of the volt meter, we have

$$G+ = R\frac{e-(n+p)}{n}$$

$$G- = R\frac{e-(n+p)}{p}$$

the equations applicable to a two-wire system. These are the same that would be obtained by solving equations (1) and (2) with z made zero.

EDWIN PLACE,
Instructor in the Laboratory of the Rose Polytectinic Institute.
Terre Haute, Indiana.

On March 8th, a St. Louis motorman, on a suburban, single track with sidings, trolley line, forgot his orders and left his switch before time. The result was a head-on collision *on a curve*. Both motormen and two passengers were fatally injured and twenty-nine seriously hurt.

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HERE, THERE AND EVERYWHERE.

Light and Power.

A system of electric lights will be put in at the harbor for the purpose of aiding the South Chicago Transportation Company in loading and unloading their car-ferries at night. Six arc lights placed at convenient intervals along the dock, will be used and the dynamo will be aboard the tug Perret, which is now undergoing the necessary improvements at Chicago. The tug is also provided with a powerful searchlight to enable it to enter the harbor with her tows during the darkest night in perfect safety. As soon as she ties up, the electric current is switched to the lights on shore and the dock illuminated, while a smaller tug takes charge of the car-ferries. By this plan much valuable time will be saved in making the round trip by a quick exchange of cars. A similar plan will be adopted at South Chicago. The system of lights will be ready for the opening of navigation in the spring.

The power plant of S. D. Warren & Co., at Smelt Hill, Maine, on the Presumpscot, has been started up for the first time. This plant was built some six years ago when the dam at the lower falls of the Presumpscot was constructed. The plant is arranged for twelve large turbine wheels. It has laid idle all this time, but recently the company has secured the right of way on the bank of the Presumpscot to Westbrook and has run a line of heavy copper wires whereon to convey the power from the new plant to the big paper mills. The distance is some five or six miles. The reason that this power has at last been transferred up the river and put into use is because of the lack of water at times to furnish sufficient power at the paper mills. They are now using only two of the turbine wheels at the Smelt Hill plant, but next week will use four of them.

Arrangements have been nearly completed by the Edison Illuminating Company for extensive storage batteries in the lighting of New York. The Edison company has been endeavoring for a long time to devise some system whereby electricity could be stored up during the day for use after midnight so that the engines and dynamos might be shut down. Two chloride storage batteries are being placed in the company's new power-house. At every hour during the day when there is a surplus of current generated, it will be switched into the batteries. When the load rises to its highest point about 6 p. m. the batteries will be turned on to lighten the strain on the dynamos. Then they will be charged up again and at midnight will be ready to assume the entire burden of lighting a district. The storage batteries will have power to light 2,100 lamps.

A large electrical company of Berlin has set an example in the use of waste coal that England and the United States may follow with profit. Near Butterfield, in the Elbe district, are immense surface deposits of bituminous coal, which is too poor in quality to pay for transportation, yet on the spot is the cheapest fuel in Germany. A year ago an electro-chemical factory was established at this place. The chief manufactures are chlorine and caustic potash, attention being also given to calcium carbide, sodium, and other products of the electric furnace, and the cheap fuel has proven so advantageous that the plant is being enlarged from a capacity of 2,000 horse-power to 3,000.

The Compania Anonima la Electricidad, of Caracas, intends developing power from two falls in the El Guaire River, the power to be electrically distributed to Caracas, and used there. The company's representative has recently visited the Niagara Falls with a Westinghouse Electric Company's man and inspected the power plant there. The combined heights of the two falls is 345 feet, and they will develop 3,000 h. p.

The city of Biella, Italy, is to get its electric power and light from the Clunsella river. The Siemens and Halske Company will make the installation which will furnish 1,500 horse-power.

The plant of the Altmeyer Electric Light and Power Company at McKeesport, Pa., was burned on February 1st and the company was forced to withdraw its bid for the city lighting. The Common Council then awaaded the contract to the McKeesport Light Company at $75 per lamp for one year, but the latter company refused to accept less than a three-year contract at that rate.

The Rockford General Electric Company has been granted articles of incorporation by the Secretary of the State. The capital is $50,000, and the incorporators are Merwin C. Wheaton, Godfrey Atkin and Jesse Scribner. Ralph Emerson will take $30,000 of the stock and the remaining $20,000 will be held equally by the others interested.

A French mining engineer is making plans of an electric elevator to the top Mont Blanc. A horizontal tunnel is to be bored, and from there to the top the ascent is to be made by electric elevators in a vertical shaft one and a half miles high. It is thought that the time for the ascent will be thirty minutes.

The Fort Wayne Electric Corporation shipped on Feb. 28th, to Bordentown, N. J., a sixty-eight light arc dynamo and one 1000 light incandescent generator with the necessary lamps, transformers, station instruments, etc.

A proposition to bond the city, of Woodburn, Oregon, in a sufficient amount to put in a first-class water and electric light plant will be submitted to the voters at the city election in March.

The City of Mexico, Mexico, is to be supplied with electrical power from the neighboring falls of Tenancingo. The Siemens and Halske Company will supply the plant.

The voters of Decorah, Iowa, decided at a recent election by 500 majority to issue bonds for the estableshment of a municipal lighting plant.

Telephone and Telegraph.

English capitalists are discussing a project for the establishment of a submarine cable between the Shetland Islands the northernmost outpost of the English telegraph system, and Iceland. England's trade with Iceland amounts to about $500,000 per annum, and it is expected that the establishment of telegraphic communication will immensely benefit this trade.

The press report of the recent Indian Council in the vicinity of Wounded Knee was signalled from the place of meeting to Deadwood by means of the heliograph, and from Deadwood was sent over the wires of the Western Union Telegraph Company. The distance from the meeting-place to Deadwood is nearly 100 miles.

The report of Chief Walker, of the Bureau of Electricity of Philadelphia, shows that the Western Union Telegraph Company has laid wires in about ten miles of conduits in that city, and the Postal has laid about seven and a half miles.

The importance of the insulated wire industry may be gauged by the fact that, in 1885, the imports into the United States of gutta-percha and india-rubber amounted to $9,697,239 worth; in 1895 the amount had risen to $19,345,072.

A Boston electrician asserts there is enough discarded cable machinery laying around in different parts of the country to make an entire cable system for the City of Boston.

Railways.

The Columbus, Hocking Valley & Toledo Railroad Company has adopted electricity for a feeder line twenty-two miles long, from McArthur Junction, on the main line, to Jackson, O., and the Westinghouse Electric Company has the contract for equipping the road and power house. The road will open large coal fields at Wellston and the mines of the Superior Coal Company. The road is laid with sixty-pound rails, and is estimated that

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a speed of thirty miles an hour will be maintained with heavy freight trains. For the passenger service light motor cars of seventy-five horse power, and eleven trailers are being built. The motor cars are thirty-eight feet long, and the seats are placed tne same as in a passenger coach used on railroads. The electricity will be fed with a trolley, the same as the Mount Holly, N. J., branch of the Pennsylvania railroad. This is the first electric road built in Ohio by a railroad company operating by steam, and is the beginning of extensions premeditated. The new line is to be completed by the middle of March.

From figures given out by some of the Chicago railway companies, it is conclusively shown that electric trolley cars are now being operated more cheaply on the North Side than cable cars. On the South Side the car mile cost of running cable cars rose from 9.972c in 1894 to 10.240c in 1895, while the car mile cost of electric cars fell from 16.904c in 18894 to 14.776c in 1895. The officials state that it is not unlikely that the results of the current year will point irresistibly to the discarding of the cable as a means of street car locomotion.

It is given out that the Presidents of both of the street railway companies in Cleveland, O., which control all the lines, are willing to negotiate with the city for the granting of universal transfers, the reduction of their fares and the payment of a percentage of their gross receipts into the city treasury in exchange for an extension of their existing franchises.

The Lake Street road, of Chicago, has progressed so far with its electrical equipment that it expects to have it in operation by the middle of next month. About one-third of the motor cars have already been completed and are ready to operate.

Under the laws of the State of Ohio any street railway company operating eight miles of track may run its cars over one mile of track of any other established road, and one mile for every additional eight miles it may operate.

General News.

An aluminum solder, made in Europe, and recently introduced in this country, works all right. It is used as ordinary solder. Very small quantities are used and heated till it commences to fuse; then place the parts to be joined in position and continue the heating untill fumes begin to develop. Where large surfaces are to be united, it is recommended that the solder be strengthened by having a little zinc or tin about the thickness of ordinary foil added to it; or the zinc or tin may be first melted directly on to the parts where the solder is to be used, and the solder applied over it in the usual way. Where it is required to connect aluminum with steel or iron, however, these metals should be first tinned over at points where the soldering is to take place. Copper and brass can be in this way directly soldered to aluminum.

In view of the enormously increased consumption of pla tinum in electric work it is agreeable to note well the accredited statement that large deposits of this valuable mineral have been discovered at Fitfield, New South Wales. It has been known for several years that platiniferous lead existed in this locality, and the deposits have been worked, though only on a small scale. It is now found, however, that the platiniferous lead is over a mile long, varying in width from 60 feet to 150 feet, and covered with from 60 feet to 70 feet of loam. The precious metals are practically confined to the bedrock and the drift for three inches above the bottom. Nuggets which weighed from a few grains up to 5 dwt. have been occasionally found. The crude metal contains about 75 per cent of platinum, and realizes at the present time upon the field 24 shillings per ounce.

It is stated that in ten years, ending with 1894, the value of the copper smelted in the Guayacan Works in Chili amounted to no less a sum than $43,000,000. This item alone is an eloquent proof of the mineral wealth of the Province of Coquimbo, which only requires roads and economic means of transportation for its development.

Bucherer, a German electrician well known abroad, propounds some new views on the theory ef elecrolysis. He proves that the E. M. F. for electrolyzing a salt, which crystalizes without a solvent, is independent of the solvent for saturated solutions. The solution tension of silver in water is found to be 40 times as great as in alcohol Bucherer urges the need of abandoning the modern hypothesis of electrochemistry as represented by Oswald, Nernst and Planck. The views, as developed by him, he thinks, have come to stay, and from their general acceptance he expects the discovery of new facts and new laws, which he proposes to dig out.

Electricity, London, says that a well-known country traveler for one of the largest electrical firms in the kingdom gives the following account of his last quarter's operations: Traveled 3,964 miles, carried four trunks, shown goods 114 times, sold goods 92 times, been asked the news 5,051 times, told the news 2,160 times, didn't know 691 times, been asked to drink 1,861 times, drank 1,861 times, changed politics 46 times, daily expenses allowed by house 32s., actual average 28s., clear profit 4s., cash on boards 10s. 6d., been to church once.

Mr. F. E. Drake, who has for years been identified with the Standard Electric Company in the capacity of general agent and assistant manager, has entered the firm of W. D. Ball & Company, Consulting Electrical and Mechanical Engineers, with offices No. 1625 Monadnock Block, Chicago. Mr. Drake's long experience in the commercial field of the industry, and his practical knowledge of the requirements of central station, isolated plant and general practice, will be of much value to the new firm and its clients.

Electricity is now used to detect paste diamonds from the genuine. A small disk of aluminium is attached to the spindle of a small motor. A clamp with a small flat spring, provided with an adjustable screw, holds the article to be tested. It is then moistened and placed in contact with the rapidly revolving aluminium disk. If the stone is a genuine one, it will be left intact; if it is bogus it will show brilliant metallic marks.

ELECTRICAL TANNING.

In the *Zeitschrift fuer Elektrochemie*, Herr Folsing states that he has worked out an electrical method of tanning, which he considers is suitable for both thin skins and heavy hides and only requires three to six days. The tanning pit contains 15,000 litres. Electrodes of nickelled copper are fixed to the walls of the pit in which the hides are hung so that the current has to pass right through them. A current of twelve amperes with an e. m. f. of twelve volts is used. The color of the leather is not quite satisfactory when commercial unpurified extract is used. The author lays stress on this and he himself uses an oak extract (with a little hemlock extract added) which is cleared and decolorized by a special electrolytic process. When this is used he finds that the color is exceedingly good and bright. Light cow hides were found to require seventy-two hours, heavy cow hides five days and heavy ox hides six days. The latter would require a year by the old process.

NEW FIRM OF ENGINEERS.

W. D. Ball & Company, Consulting Electrical and Mechanical Engineers, 1625 Monadnock Block, Chicago, is the style of the firm succeeding the partnership of Ball & Allen which has been dissolved. Mr. Allen retiring.

The new firm is composed of Mr. W. D. Ball, who has been well known in engineering circles for several years, and Mr. F. E. Drake, formerly the general agent and assistant manager of the Standard Electric Company.

The new firm will continue to do consulting and engineering work. Mr. Ball takes the technical end while Mr. Drake will have the management, caring for the general business.

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Electricity is Tangible Property.

Judge Cooper, of the Criminal court of Memphis, Tenn., on Feb. 17th, handed down a decision holding that electric current was property and could therefore be stolen and that such larceny was an indictable offense.

The question came up on a motion to quash the indictment against W. Wellman, a livery-stable keeper, who, it is alleged, tapped his own circuits and enjoyed the use of a greater number of lights then he contracted to pay for. The counsel for the defense took the position that the current was not personal property of a kind that one man can carry away and deprive another of. The wires and poles might be conveyed away, but the current could not be segregated from its whole. In this case the defendant had paid for the wiring in his premises, and, if he chose to attach another wire to these circuits, he could not be held responsible, if the current diverted itself and followed the new wire.

The prosecution took the ground that the current was on the same basis as water and gas delivered in pipes, and, as the case had never before been decided by any tribunal, it behooved the court to decide it along the lines of common sense, common law and the statute concerning larceny. The court took this latter view of the case and the motion to quash was overruled.

This decision if sustained by the higher courts will be of much benefit to central station people; and there is no reason why it should not be sustained. It is a crime under Federal law to tap telegraph wires, although no more real property than *Intelligence* is stolen, and it is likewise criminal for telegraph companies or their employes to *give away* any information that comes to them as common carriers, the presumption being that such information is *property* and belongs to their customers.

There have been decisions as we know, holding that the electrical current has no material existence, and is consequently not property. We sincerely trust that the highest courts may be called upon to enforce Judge Cooper's decision so that property rights of central station managers may be as safe as those of other people. As the matter now stands every central station manager must keep on his staff a special expert, versed in the ways of the transgressor who makes connections in walls, under floors and behind meters. And even if a theft of this kind is detected it is usually regarded as a good joke, but not criminal or even reprehensible.

* * *

World's Fair Medals at Last.

Congress has just passed a resolution ordering the secretary of the treasury to distribute the World's Fair medals and diplomas, and appropriating money for the purpose. A clause in the resolutions runs in effect that where exhibitors cannot be found, the medals and diplomas shall remain in the hands of the secretary of the treasury. What a commentary this is on John Bungler Thatcher's committee, and not less of a rebuke is the action of congress to President Cleveland who has been sponsor for Thatcher. Of all the scandals and disgraces that this national administration has heaped about itself, there is hardly one more urgently calling for the wrath of the people, because Mr. Thatcher was appointed at Mr. Cleveland's instance, supported through all his ignominious failure by the same power, and we are ready to predict that a careful investigation will divulge the fact that the power of the committee—meaning Mr. Thatcher—has been traded off in due course of politics. At any rate, those exhibitors who have not died, or failed in business because of President Cleveland's brilliant administration of the country's finances, will now get their awards.

* * *

Judge Townsend's Just Decision.

If this country were blessed with a few more jurists like Judge Townsend of the United States Court, the patent laws of the country would not be the easy mark they are for every pettifogging attorney who is willing to take his fees on the contingent plan. In another column may be read a decision of Judge Town-

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send awarding to the Thompson-Houston Company the right to make and see all the parts of the under-running trolley mechanism peculiar to the patent, the validity of which was but a few weeks ago upheld in the same court. By this last decision the court serves notice that a United States patent confers a monopoly which holds during its life. Unless the Supreme Court shall upset this beneficent ruling, we shall see American patent values take a far forware stride, and eventually if this thing goes on our patents may be worth the actual money invested in ribbon gilt paper and the ceiling wax with which they are granted.

* * *

Mr. Tesla's Oscillator.

We have been waiting quite patiently, since the appearance of so many columns of matter on the subject, in the daily papers, to know authoritatively what Mr. Tesla has done for the medical world with his oscillator. In a circular letter which he has been sending to inquirers, he has made a strong point on the difference between mechanical and physiological "vibrations." He does not say what the difference is, how arrived at, or what that difference means to the physiologist. Vastly too much has been said and written about Mr. Tesla's work along physiological lines, or vastly too little. If he has accomplished what the news papers have been stating, he should give more details at once, as his discoveries are too important to be hidden for a moment longer. If Mr. Tesla's confidence has been abused by some of his newspaper friends, he owes it to himself to say so, and knowing Mr. Tesla, as we do, for a thoroughly honest and earnest worker in the field of science—and for science's sake, we are quite sure that something is wrong, for which he is not responsible. The direction of Mr. Tesla's work is recognized by medical men as likely to lead to discoveries that will measure up with the work of Harvey, Hunter, McDowell, Jenner, Lister and a select few. We would be greatly disappointed to find either that unwise friends had prematurely divulged Mr. Tesla's hopes, or that Mr. Tesla, himself, had been disappointed in his results, based on limited knowledge of physiology.

* * *

Our British Brethern have risen in their wrath and might and are prepared now to grapple with the telephone subject from every side of the question. The United Kingdom Telephone Defense Association has been organized with such men as Prof. Sylvanus P. Thompson, R. E. Crompton and Major-General Webber at its head and is prepared to demand a more efficient service. It would be interesting to watch the outcome of a collision between that ponderous association and a Chicago Telephone Exchange girl who happened to be in particularly bad humor when she called back, "Busy, please call again." And the thought occurs to us to ask how about that claim of Superintendent Wm. H. Preece that the telephone service in England is the best on earth. Perhaps this new "Defense" Association is organized, after all not to demand a better service, but to "defend" Mr. Preece's claim.

* * *

Our neighbor's heart strings and his purse strings are the same, and they are closely tied up to his voice strings, otherwise vocal chords. Hence a steam fog whistle is as the gentle murmur of a soft summer sea, or the soothing sighing of a turtle dove breathing the light and feathery airs of love across the gathering shadows of evening, as compared with the wail that follows the jerk on the strings occasioned recently by THE ELECTRICAL JOURNAL in due course of business.

* * *

A project is on foot in England to establish telegraphic communication between that country and Iceland. Following so close on the heels of the announced discovery of the North Pole, this looks like the usurpation of new territory. We are wondering if the Aurora Borealis will be inventoried as one item of the assets to be transferred to her British Majesty's capacious lap.

RICHARD HENRY PIERCE.

The subject of this sketch is entitled to a large share of the credit for what the electrical service of the Worlds' Columbian Exposition was. Indeed Mr. Pierce took up the work of the construction department as chief, just before the opening of the Fair, when it was in a most deplorable condition. In an almost incredibly short space of time he brought order out of chaos and finally gave a most creditable service even at the outset. It has been said that he is the greatest benefactor of his kind who makes two blades of grass grow where only one had grown before. Mr. Pierce "made hay" it is true during the Worlds' Fair, but his chief crop was currents, some of which were preserved to feed the launches and some were squeezed for their "juice."

Farmer Pierce was born "down East" at Woonsocket, R. I., just as the frost was ripening the pumpkins in the fall of '60. He graduated at Yale College in the class of '82 with the degree of A. B. and afterwards graduated in 1885 in the first class of Electrical Engineers ever turned out from the Maassachusetts Institute of Technology. He at once went to work in the electrical field with the Edison Illuminating Company, of Brockton, Mass. A year later he went to the Western Edison Company of Chicago, and stayed there in one capacity or another, usually as expert, until he became assistant Electrical Engineer of the Big Exposition. It was in April of '93 that he became Chief, one month before the time of the opening. Mr. Pierce as one might judge from his benign and "I'm all right" smile, has the happy faculty of making fewer chips and less noise while he chops a bigger pile of wood than 'most anybody.

The St. Louis tunnel is an excellent place in which to substitute electricity for steam in the movement of trains. Notwithstanding the speed with which travelers are carried through this subterranean connection between the Union station and the great Eads bridge, considerable discomfort is experienced from the fumes of carbonic acid gas that enter in spite of the closed transoms; while the smoke and steam that shut in the train increases the danger of accident.

* * *

As might have been expected, the Roentgen discovery has been discredited as to its novelty. A Cleveland family has unearthed a pre-historic encyclopedia which describes a similar process, and dates it back over a century, and the Chinese have not even been heard from as yet.

* * *

The telegraph is getting a reputation for deadliness that bids fair to outstrip the trolley wire. A compilation of the late dispatches from Cuba shows that in the present war there, only 300 Spaniards have been killed, while the insurgent loss foots up to something over 9,000.

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ELECTRIC BRAZING TOOL.

Zerener's Method of Electrical Soldering, Casting and Welding is in Use in Many Branches of the Iron Industry in Germany.

Welding and soldering by electricity has of late years, and especially since the publication of the Elihu Thompson patent in 1886, attracted the attention of a number of professional men. There are now four systems in use—viz., those of Thompson, Benardos-Slavianoff, Zerener, and Lagrange-Hoho. Each distinctly differs from the others in principle.

The actual introduction of Zerener's method into several of the larger establishments of the iron industry, enables us to fully report on it and on the latest type of apparatus employed. Mr.

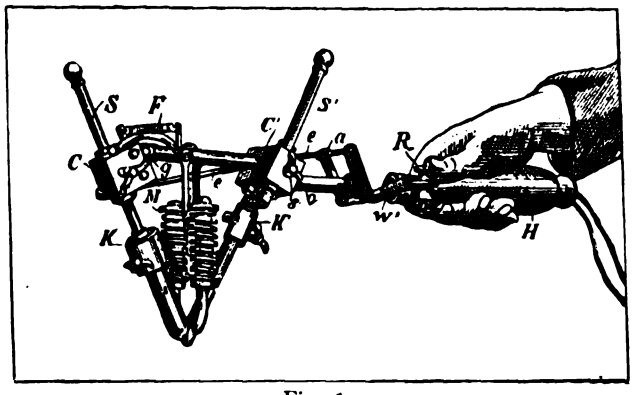

Fig. 1.

Zerener, as the outcome of a long series of experiments and arduous trials, states that if the magnetic lines of force of a horseshoe magnet and the lines of the electric arc cross each other horizontally and rectangularly in a plane, the arc becomes vertically diverted to this plane and resembles a blow-pipe flame. He characterises, therefore, his welding and soldering apparatus in combination with the winding of the horseshoe magnet as contrivances for producing a blow-pipe flame from the arc between two carbons. The arc is placed in such a way in a magnetic field—formed by two magnetic poles opposite each other in position—that the magnetic and electric lines of force, as before mentioned, cross each other. It may here be mentioned that it is important for practical purposes that the flame should be steady. To ensure this, due regard must be paid, not only to the quality of the carbons, but also to the combination of the solid and cored carbon rods. A special kind of core, or the passing of gaseous or solid substances through an axial bore of the carbons, may also at times be advantageous. It is essential that the carbons should be of a very hard quality.

In Fig 1 is shown an apparatus for hard soldering, which is simple and light. The tube, *o*, which is fixed in a wooden handle, H, and bent, carries immediately behind the first bend a rectangular body, C^1, of non-conducting material. This holds a brass tube to guide a round rod, S^1, provided with groove, which can be moved up and down, and which carries the carbon-holder, K_1. The corresponding insulating body, C, serving the same purpose, is pivoted at the joint, *g*, and connected with the end of tube, *o*. The rods, S and S^1, are kept in place and adjusted by the screws, *s* and s^1. On the left side of the handle, H, is provided a bell-crank lever, one side of which, *w*, is governed by a screw, R, whereas the other side is curved and carries on the right-hand side of the handle, at *a*, a thin connecting rod, *e*, which leads to the insulating piece, C, and can move the same. It thus causes the carbon in the holder, K, to approach the other carbon and to touch it at the point. The spring, F, tends to produce a movement in the opposite direction of the movable piece, C. The workman therefore has to turn the regulating screw, R, with his thumb to either the right or the left, according as he wishes to press the lever down or lift it up, in order to move the carbons together or to separate them. This apparatus requires, according to the melting point of the respective materials to be soldered, a current of from 18 to 50 amperes with about 65 volts pressure.

The details of a larger apparatus are reproduced in Fig. 2. The apparatus, which is suspended over the work, can be moved in a horizontal and vertical direction, and is guided by means of a handle, protected from the radiant heat by sheet iron; also in this case the relative positions of the carbons and the magnetic poles are altered. The two parts, S and S^1, which carry the carbon-holders, are brought against one another through pulleys, F F^1, between the parallel-motion rods, *u* and *h*, under an obtuse angle, in such way that the point of the negative carbon comes always to be below the crater of the positive carbon. A chain, T, running over pulleys connects the movable holders with the regulating mechanism, which is placed above the triangular frame and the heat reflector, W. This regulating mechanism may vary in construction, but has to deviate so far, more or less, from that of an arc lamp, as the use of much stronger currents has to be taken into consideration, and likewise the effects of a very high degree of radiant heat. The regulating mechanism (Fig. 2) is therefore placed in comparatively high position, besides being protected by a heat reflector of German silver. The illustration shows mainly the angular frame-plate, with the commutator, R, mounted upon it, which latter effects the feeding of the carbon, and, further, the shunt arrangement, S, which, at the start, has to form the arc, and has also partly to maintain it. The slight alteration in the sliding contrivance of the carbon-holders which is shown can be entirely ignored. The commutator, R, is formed by an electromagnet in the shunt, before which an armature, *a*, provided with a cut-out, when a certain pressure is exceeded, oscillates under the influence of the spring, F, thus causing a ratchet wheel to rotate, and likewise, by means of gearing, part of a shaft revolve. The wheel is on the same axle as a pair of pulleys, with which it is connected by friction. The pulleys can be moved to and fro independent from the clockwork with which they are connected by a key on the extended shaft, which can be seen projecting in Fig. 2. Over these pulleys is the chain, T,

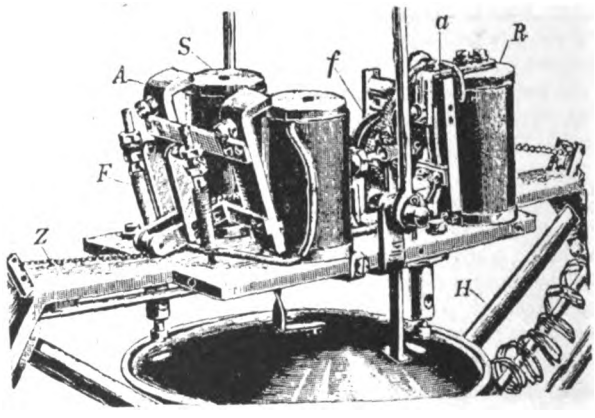

Fig. 2.

which at this point is marked Z. The second part, S, of the regulating mechanism consists of a pair of electromagnets, in front of which are placed the armatures, A, bent at the top. To these is fixed a lever carrying two little pulleys. Two springs, F, work against the attracting power of the magnets. The chain, Z, being placed over the pulleys, as shown in the sketch, the free end of it, Z^1, moves upwards and downwards with the carriage of the carbon-holders, according to the action of the armatures, A.

The self-regulating apparatus are also made for various strengths of current of from 35 to 250 amperes, and, as mentioned before, varying in construction. Special protection against the strong light and the radiant heat is naturally provided for. Zerener's spectacles may be mentioned here as well adapted for the purpose. The lower half of the glasses is of such colour that the eye can see through it straight into the welding flame with

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out any harm to the sight, whereas the upper half is of such peculiar tint that even by ordinary daylight the work can be seen in all its details.

Zerener's apparatus is constructed and adapted for a great variety of work, and it is evident that injury to the metal can be entirely avoided by the possibility of employing the source of heat at any desired distance from the object to be worked upon, which is impossible when the latter itself, serving as electrode, is exposed to a heat of several thousand degrees. Another advantage is the possibility of regulating the heat effect of the arc. Such apparatus can be employed wherever there is a dynamo machine going, and will be found extremely useful for repairs to engines and machinery without taking them to pieces.

WHERE IS EDISON "AT" NOW?

London *Lightning* prints the following communication from some unknown source which shows that Edison's high potential coast defense electricity has been put through a step-up transformer on the other side:

"A most important invention, likely to have far-reaching, indeed, entirely revolutionary effects in the art of modern warfare, has, so it is stated, been recently perfected, and is immediately to be offered to the British military and naval authorities. So far, the invention, which is entirely an English one, has been developed in private, though on a scale sufficient to demonstrate its absolute practical importance. Naturally the details are kept strictly secret, but it is understood that the invention is the result of a brilliant discovery based upon long and patient investigations in electrical science.

As is well known to every electrician, the phenomena of electrical oscillations, first noticed by Farrady, treated mathematically by Clerk Maxwell, developed by Crookes, and experimentally verified by Hertz and Oliver Lodge, have for some years past presented a field of great interest to the scientific explorer. More recently the subject has been pursued by numerous scientists, including notably Professor J. J. Thompson at Cambridge and Monsieur d'Arsonval in Paris, while during the past year interesting experiments dealing with the subject have been shown by Professor George Forbes and Mr. A. A. C. Swinton at the Royal Institution and by Mr. A. E. Mayor at Woolwich.

Many of the experimentalists above alluded to have had, among other purposes, the attainment of some method whereby, by means of electrical oscillations, energy generated in any particular spot could be transmitted through the luminiferous ether without appreciable loss, without wires or other conductors, and concentrated upon any desired object, however distant, and this despite intervening obstacles.

This power, dimly sought after with a view to benefitting the useful arts of peace, is now said to have been completely attained in its application to the destructive processes of war.

As already mentioned, the precise details of the invention are for the present unpublished, but this much may be said as to the results that are claimed on its behalf. By means of a readily portable apparatus, the mechanical energy developed by powerful steam engines, such as those of a war vessel, is converted into wave energy in the luminiferous ether that prevades all space. This in turn by ingenious arrangements can be propelled in a continuous stream in any given direction, and caused to concentrate, or focus, at any desired point even many miles distant. There the energy is liberated with an enormous evolution of heat and a volcanic disruptive force that immediately anhilates every person and every thing within an area that can be enlarged to any desired extent by a slight motion of the directing mechanism:

So far as is at present understood, nothing can arrest this terrible though impalpable beam of destruction.

As is well known in the case of the experiments of Hertz, walls and stones, and, in fact, all bodies usually considered opaque, are transparent to these electrical rays. The remarkable photographs of Professor Roentgen are based upon this fact.

Not long ago Professor Oliver Dodge demonstrated this principle at the Royal Institution, by producing electrical effects at one end of the building by means of a small electrical machine in a distant apartment, though there were no wires or electrical conductors between the two places, which were, indeed, separated by several thick and solid walls of masonry. It is understood that the new invention works upon similar principles, though upon a scale and through distances stupendous in comparison.

For the present no more can be said, except that it will be a strange case of history repeating itself should the latter end of nineteenth century see an English fleet destroying, say, New York or Hamburg from a distance beyond the reach of all artillery, in much the same way as Archimedes is fabled to have set fire to the Roman fleet at Syracuse, more than twenty centuries ago, by means of a burning-glass."

PHILADELPHIA'S ELECTRICAL BUREAU.

Chief Walker, of the Electrical Bureau of Philadelphia has just submitted his report for last year to Director Beitler. The report states that close supervision is maintained over the system of electric lighting; daily reports are made of lamps which failed to burn a portion or all of the previous night, and fines are imposed for all failures to supply lightts in accordance with the contracts and specifications. At the close of the year 1894, there were 5293 street lamps maintained at the public expense, 50 by the Board of City Trusts, 46 were lighted free of charge by the electric light companies, and 3 on Girard avenue bridge maintained by the People's Traction Company, making a total of 5392 lamps. At the close of the year 1895 there were 6228 lamps maintained at public expense, 50 by the Board of City Trusts, 80 by the several electric light companies and 3 on Girard avenue bridge, making a total of 6361 lamps. During the years, fines for 11,863 lamps at an average price of 41.15 cents for each were deducted from the bills of the companies for failure to comply with the contracts, and the amount $4,881.62 remained in the City Treasury out of the general approprirtion for lighting.

There were 548,713 messages sent over the police wires and 36,439 messages transmitted over the telephone circuits, while 482,585 connections were made on the switchboard of the bureau between the offices attached to the city's system. There were also 738 alarms of fire transmitted over the wires. On the police signal and telephone system there were 4,339,048 calls, of which 47,129 were for the wagons. Of the wagon calls, 20,689 were for the conveyance of prisoners, 7,458 for the removal of injured persons, 1,158 for conveying patrolmen to and from fires and 8,797 for miscellaneous work.

At the close of the year there were 56,731 wood and iron poles maintained by the various electric companies, of which 41,750 are used by the street railways. There were also 6,333 wood and 1,764 iron poles belonging to the city, making a total of 64,828, an increase for the year of 23,179. The overhead wires in use were 2,675.65 miles of telephone and telegraph; 1,324.77 miles of electric light wires; 1,415.34 miles of city wires, and 570.12 miles of trolley wires, making a total of 5,985.18 miles, an increase of 610.63 miles over the preceding year.

THE CHICAGO TECHNICAL CLUB.

The recently elected Board of Directors of the Chicago Technical Club, met on the 17th inst., and discussed the question of permanent quarters for the organization. Several very favorable offers are under consideration, but, as yet, no decision has been reached.

Mr. C. E. Billin, secretary of the club, states that there is no lack of advantageous locations, and the difficulty is in deciding between them. The question will probably be settled within the next week and the club will be fairly launched on its career.

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REPORTING THE CONVENTIONS.

How the Western Union Will Handle Press Reports, Bulletins and Private Messages in St. Louis and Chicago.

ABOUT FIFTY MILLION WORDS WILL BE SENT.

That the people of these United States take a deep interest in National politics is evidenced by the fact that one telegraph company alone, the Western Union, has handled out the quadrennial conventions of the two great political parties, from twenty to thirty million words for each and every one

This includes everything that pertains to the convention, private and press dispatches, but does not include the ordinary commercial and usual telegraph business of the city in which the convention may be held

The amount of telegraph business done at these conventions varies, of course, with the importance of the occasion. A bitter and aggressive party fight in the convention augments the business to a remarkable degree, for, public interest is intense, bulletins are issued as fast as can be sent out, the afternoon papers are sending out "extras" on the slightest provocation, and last but not least the interested parties in the convention and *elsewhere* are using the wires with reckless freedom for important private messages.

It goes without saying, that a long drawn out convention makes more work for the telegraph companies than a short one, but according to Mr. C. H. Summers, Chief Electrician of the Western Union Telegraph Company, sessions held at night do not increase the volume of business as much as might be thought. It merely transfers a large amount of press business from the main office of the convention city, to the office in the building in which the convention is being held. With no night sessions the members of the press are engaged in compiling and sending out dispatches, which embody everything, from rumors to interviews on the situation. During a night session they are just as busily engaged with the work in hand.

Past conventions afford no criterion of the amount of telegraph business to be handled at those to come in the future, according to Mr. Summers, who has directed the Western Union telegraph convention arrangements for the past twenty-five years, so that he is unable to give even an approximate idea of what business his company will do. He is, however, certain that no emergency can arise, either in St. Louis or Chicago this year that cannot be promptly taken care of.

Mr. Summers, as usual, will have full charge in St. Louis and Chicago, and his plans are already matured. From the main office in Chicago and St. Louis, from 25 to 50 main wires will be laid from the office in the convention hall, these to reach to every point in the country. These will receive their current from the dynamo plants of the main offices, but will otherwise have no function in the main offices, no repeaters being used. In other words, they will be independent of the main office except for current.

The main office in the convention building will be apart from the convention hall proper, but, will be in the closest communication with it. From forty to fifty operators will be kept busy and multiplex instruments will be largely used. A force of messengers, in number from 50 to 75, will keep open the lines of communication, not only for the press but for the delegates. Near the Chairman's table will be a force of special Western Union reporters, who will relieve each other, and whose sole duty will be to prepare bulletins. These reporters will be provided with a pneumatic tube, the plant for which will be run, probably, by a small motor. This tube will put them in almost instantaneous communication with special operators and the proceedings will be reported throughout the country with the least possible delay.

During the day the Convention Hall office will handle private messages, bulletins and press reports for the afternoon dailies. Should there be no night session the press reports for the morning papers throughout the country will be taken care of at the main office. Even with a night session much of the matter for the morning press would be handled at the main office, for the reason that it would be already prepared for transmission between sessions so that nothing would be left except the report of the proceedings of the night session.

Two weeks before the convention will be held, a force of linemen will be employed to place the wires between the Convention Hall and the main office, and the day before the convention opens, Mr. Summers will have personally assured himself that his arrangements are absolutely perfect and that no possible hitch can occur that can not be immediately corrected.

GENERAL ELECTRIC-WESTINGHOUSE COMBINATION

An Amicable Agreement has been Arrived at Regarding the Patents Owned by the Rival Companies, and as a Result much Litigation will be Dispensed With.

After many months of conference between committees of the Boards of Directors of the Westinghouse and General Electric Companies an amicable understanding regarding the use of the patents controlled by the rival concerns has been arrived at There has been for some time a general opinion that Judge Townsend's recent decision in regard to the under-running trolley, and the fact that the General Electric Company controlls these patents, while the Westinghouse people control the equally valuable Tesla patents, would have much to do with bringing about this result, and pending litigation would be stopped.

Secretary Terry of the Westinghouse Company states that the following is the official agreement between the two companies, and this simply confirms the above:

"Negotiations between the General Electric Company and the Westinghouse Electric and Manufacturing Company have resulted in an arrangement with respect to a joint use of the patents of the two companies, subject to existing licenses, on terms which are considered mutually advantageous.

It has been agreed that after certain exclusions, the General Electric Company has contributed 62½ per cent and the Westinghouse Electric and Manufacturing Company 37½ per cent in value of the combined patents, and each company is licensed to use the patents of the other company, except as to the matters excluded, each paying a royalty for any use of the combined patents in excess of the value of its contribution to the patents.

The patents are to be managed by a board of control, consisting of five members, two appointed by each company and the fifth selected by the four so appointed, Both companies have acquired during their existence a large number of valuable patents and numerous suits have been instituted in consequence of the infringement of these patents by one party or the other or by their customers. In the prosecution of these suits large sums of money have been expended, and the general expenses of the companies have in this manner been greatly increased. It is expected that the economies to be effected will be very considerable, and that the two companies and their customers will be mutually protected.

The especial incentives which led to the arrangement, arrived at this time, were the recent decisions in favor of patents of the General Electric Company controlling the overhead system of electric railways, the approaching trials of a number of other important General Electric patents on controllers and details of electric railway apparatus and systems and other electric devices and the equally strong position of the Westinghouse Company in regard to power transmission, covered by patents of Nikola Tesla, and in view of its other patents in active litigation, some of which are of controlling importance."

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ELECTRICITY IN WARFARE.

Lieut. J. J. Blandin, of the United States steamer Endeavor, made an address a few nights since, before the Maryland Naval Reserves, on board the Dale, on "Electricity in Naval Warfare." He said:

"The uses of electricity in naval warfare may be grouped under five main divisions—signals, lighting, motors, torpedoes and gun-fire.

"Electricity is used almost exclusively for 'interior' signals, that is, in making signals from one part of a ship to another part of the same ship, and very largely in making signals from one ship to another, or for 'exterior' signals.

"For interior signals the instruments are usually grouped in pairs, one to show what is being done, called an indicator, and one by which orders may be transmitted, called a telegraph. Thus there are the helm indicators and helm telegraphs, engine indicators and engine telegraphs, range indicators and range telegraphs. Besides these there are telegraphs, telephones and voice tubes to various parts of the vessel.

"Another important set of interior signals are the automatic fire and water alarms. These are placed in each water-tight compartment and coal bunker and automatically warn the captain of fire and water and the location of the trouble.

"For exterior signals there is a set of double lanterns, by which thirty combinations can be formed quickly and signals made rapidly and with certainty.

"Electric lighting has been of the greatest value in the development of the modern war vessel. The United States steamer Trenton was the first war vessel fitted with electric lights, and since then, their use has become general. Electric lights are used throughout our modern warships and greatly increase their efficiency.

"Electric motors are being more generally used every day on board of warships for turning turrets, hoisting ammunition, running ventilating fans, and for hoists of all kinds. An electric wire can be run through and to places where it would be difficult to run piping for steam, compressed air or hydraulic power. Repairs can be quickly and easily made to an electric wire if it should be cut by a shot, but repairs to piping would be almost impossible in action.

"The torpedoes used on board of war vessels are usually of the auto-mobile type, and electricity pays a very small part in their manipulation. There are also the controlled torpedoes, like the Sims-Edison, which would be used from a land battery. In stationary torpedoes or mines, such as are used to defend a harbor, electricity is the all-important agent for exploding the right torpedo at the right time. This is the torpedo work of greatest interest to the naval militia."

An explanation was given by Lieutenant Blandin of the method of locating a hostile vessel passing over the place defended by torpedoes, and how the mine is exploded just as the vessel gets over it.

"For gun-fire," he continued, "the range-finder is used to determine the range, the telegraphs are used to inform each gun of that range, and the electric primers are used, so that the whole gun-fire of the vessel may be controlled by the captain of the ship when desired.

"The theory of fighting a modern warship is that all its energies shall be concentrated in the hands of the captain. To do this electricity is used as being the quickest, surest and in many instances the only agency available. It is important that a body like the naval militia, intended principally for home defense, should know the general scope of the usefulness of electricity in warfare and should familiarize itself in particular with the uses of this power as applied to harbor defense."

One mile of the electric underground tunnel in London has been driven during the past six months. It is to be completed July 1.

The subscription price to the ELECTRICAL JOURNAL is $2.

RENEWING EDISON FUSE PLUGS.

An Easy Method of Accomplishing an Apparantly Difficult Task—Fuses Should Be Renewed Frequently.

Anyone who has tried to put a piece of fuse wire into a blown plug with an ordinary soldering copper knows that it is nearly impossible to acdomplish it, for unless you use a very small copper the fuse itself is melted off before the solder on the terminal at the bottom of the plug melts.

There is an easy way to renew fuses in these plugs requiring only such apparatus as can be found in any lighting station. The bottom contact piece extends through the glass and projects on the inside where one end of the fuse wire is fastened. If you heat this piece from the outside the solder will melt and all that is necessary to do is to dip the end of a piece of fuse wire in acid, then put it in the melted solder in the bottom of the plug and remove the source of heat. It is an easy matter to solder the upper end of the fuse to the other terminal with an ordinary soldering copper. If you have a small gas stove such as is used to heat soldering coppers, place the plugs bottom down on the top of this stove and they soon get hot enough. When the solder melts take the plug off the stove and put in a short piece of fuse wire. If you have no gas stove, place a piece of sheet-iron in a horizontal position and direct the flame of an ordinary blow-torch on the under side of it, put the plugs on top over the flame and they are readily heated sufficiently.

In the absence of both of the above, heat a piece of flat iron, remove it from the fire and place the plugs to be repaired on it. This is not so convenient as the above method, for the iron soon cools and has to be re-heated.

Plugs renewed in this way are really more reliable than new ones, for you can use a reliable tested wire which you know from experience will blow when a certain known current is passed through it, while if you go by the markings on the ordinary new plugs and do not look inside, you may put in a 40 amp. fuse where only a 5 amp. should be used. We have a lot of plugs here all marked 2 amp., several of which contain a wire of four times the cros section of that in the others.

It has been shown conclusively by the results of recent elaborate tests of fuse wires that they should be renewed frequently on important circuits, for the wire during use undergoes an internal change which changes its rating and makes it very unreliable. The above furnishes a ready means to renew such fuses at a very small expense.—*J. J. Green.*

VALUABLE TELCHNICAL PAPERS.

The first number of the *Journal of the Western Society of Engineers*, which will be issued bi-monthly hereafter, contains some valuable and interesting material for all classes of engineers. Among other papers, may be noticed, as being of interest to electrical engineers, the Development of the Experimental Study of Heat Engines, by Prof. F. C. Unwin; The DeLaval Steam Turbine, by W. F. M. Goss; Gas and Petroleum Engines at the Antwerp Exhibition of 1894, by G. Lambotte, and Water Power, It's Generation and Transmission, by S. Webber.

There are, besides, other papers on engineering subjects which are worth a careful perusal.

GOOD TRADE FOR THE METROPOLITAN.

The Metropolitan Electric Company report recent large sales of P. & B. tape and compound. The spring construction has begun rather early. These goods are found to be as reliable as of old. The Metropolitan Electric Company are fortunate in having this agency, and have increased the business west since it has been in their hands very considerably. They are also having some splendid orders for Ship core carbons, another specialty of the Standard Paint Company, for which the Metropolitan Electric Company are Western agents as well.

The electro-magnet applied over the arm will detect, says Ulrich, the situation of a needle imbedded nearly a centimetre in the subcutaneous fatty tiseues.

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ELECTRIC HEATING COMPANIES COMBINE.

Seven Active Concerns, as Well as Several Not in Business, but Owning Valuable Patents are Merged into one Corporation.

After six months of negotiation the absorption of all the important electric heating companies has been effected by the American Electric Heating Corporation, head office at Sears Building, Boston, and the control of the new consolidation will pass into the hands of a syndicate including Charles A. Morss, Wm. Endicott, Jr., Charles E. Perkins, Charles J. Paine, Oliver Ames, E. S. Converse, C. C. Converse, E. L. Corning, Thomas Nelson, E. N. Fenne, A. R. Whittier, Jackson & Curtis, E. D. Barbour, Robert Bradley, Peter Bradley, Robert Treat Paine, Jr., and others.

The new Board of Directors will consist of J. Murray Forbes, president; Charles A. Morss, Jr., Edward C. Perkins, Charles L. Edgar of the Edison Electric Light Company, Charles Francis Adams, Everett Morss, Arthur B. Smith, Geo. U. Crocker, Ambrose Eastman, of Boston, S. S. Wheeler of the Crocker-Wheeler Electric Company, and Arthur M. Dodge, of New York; and H. B. Scott, of Burlington, Iowa.

The concerns absorbed by the American Company, are:

The Western Electric Heating Company, St. Paul, Minn.

The Central Electric Heating Company, New York.

The New England Electric Heating Company.

The Burton Electric Company, Richmond, Va.

The Carpenter Electric Heating Manufacturing Company, St. Paul, Minn.

The Dewey Electric Heating Company, Syracuse, N. Y.

The Rich Electric Heating Company, Mt. Vernon, N. Y., as well as others which have not been active in the business for some time, but which owned valuable patents.

Heating by electricity is now a commercial success, and in addition to the large number of patents now owned by the American corporation, it also owns the patents covering the enamel process, which has already proved of great value fn rheostats, and it is believed will be of equal importance in many other devices.

The opportunity for the application of electric heating in industrial establishments is very large, and recognizing this, the company has established a laboratory for special work, which will enable it to care for this class of business in an intelligent and satisfactory manner. The line of cooking devices now on the market, as well as, other domestic appliances, such as small stoves, laundry and tailors' irons, etc., is quite complete, and a considerable business is being done. During the past season many thousand car heaters were sold by the company. While much of the product has been very satisfactory, that which is not so, will receive immediate attention, and several improvements are in hand which will prove to be desirable additions. This especially applies to cooking apparatus. car heaters and special industrial devices.

The slow progress heretofore made in electric heating has not been owing so much to difficulty in perfecting devices, as to want of concentration of patent rights and management, and to insufficient capital.

The policy of this company is to furnish the best that the state of the art will permit, and they are provided with an able corps of practical men to insure this. They begin business with ample capital, and with a list of stockholders, and a board of directors composed of substantial and conservative business men.

The manufacturing will be concentrated at Cambridgeport, and the head office is at 611 Sears building, with agencies in New York and Chicago. Mr. James I. Ayer, ex-president of the National Electric Eight Association, is the general manager.

The subscription price to the ELECTRICAL JOURNAL is $2.

PATENTS MATERIALLY STRENGTHENED.

Parts of Patented Articles Must Be Bought From the Patentee or Assignee.

Judge Townsend, of the United States Court, handed down a decision a few days since in the case of the Thomson-Houston Electric Company against the Kelsey Electric Specialty Company of of New Haven and the Billings & Spencer Company, of Hartford. This action was brought to restrain the defendants from making and selling a certain type of trolley stand, and the proceedings were based upon the decision of the court in the case of the Thomson-Houston Company against the Winchester Avenue Railway, of New Haven, in which some of the Van Depoele patents on the "under-running" trolley were sustained. Judge Townsend directed the issuance of a permanent injunction restraining the defendants from making the appliances complained of or any part of them. The Billings & Spencer Company was the maker of the forgings for the appliances.

The defense set up that the trolley stand and other equipment when purchased by trolley roads from the Thomson-Houston Company brought this outside of the patent; that is to say, they bought it with all the rights of purchase to sell again or do as they saw fit. That the device in question is only a part of the patent and if this part should break it can be replaced or repaired without obtaining the parts from the patentee or his agents. It was argued that if this is not so the purchaser of a trolley car would not be able to buy even a trolley-wheel or a bit of pipe for a trolley arm.

Judge Townsend, after carefully reviewing the facts, states that if it were just that one person could supply one part and another some other part, the owner of the patent would be deprived of the monopoly which is intended when the rights are granted. Judge Townsend states, in substance, that such parts of a combination can be supplied as are regular articles of commerce, such as bolts, screws and springs. When a part of a combination is of a design peculiarly adapted to the device and is manifestly intended for no other, then it is an infringement. By this decision the Thomson-Houston, or rather the General Electric Company is given the exclusive right to make, sell and renew all the important parts of under-running trolley equipment.

THE TROLLEY IN JAPAN.

An electric tramway established at Kioto, in Japan, is described and illustrated in *L'Energie Electrique*. The tramway has been laid by the Thomson-Houston Company, and the current is taken from a central station, which supplies power to a number of silk-mills as well as the elcetric lighting of Kioto. The source of power is a canal from Lake Biwa, which is also used for navigation and irrigation purposes. There are twenty Pelton wheels of about 120 h. p. working twelve dynamos, arrangements being made for the employment of alternating currents of from 1,000 to 2,000 volts, and a three phase system at 1,000 volts, as well as a 500-volt continuous current, the total output being at present about 1,200 kilowatts. One curious feature is an inclined plane 700 meters long, with a fall of seven per cent, which is used for transporting barges from the canal to the River Ujigawa; and vice versa. This is worked by a cable, driven by a 50-h. p. Thomson-Houston motor. The electric tramway is eighteen kilometres (11¼ miles) long, and is worked with twenty-six cars fitted with Thomson motors. It is stated that the results of this tramway have been so encouraging that the Municipalities of Tokio, Yokohama, and Osaka, have decined on adopting similar lines.

The Common Council Committee on Municipal Lighting of the city of Buffalo has resolved to ask the State Legislature for permission to issue bonds to the amount of $300,000 in order to raise funds for establishing a municipal lighting plant.

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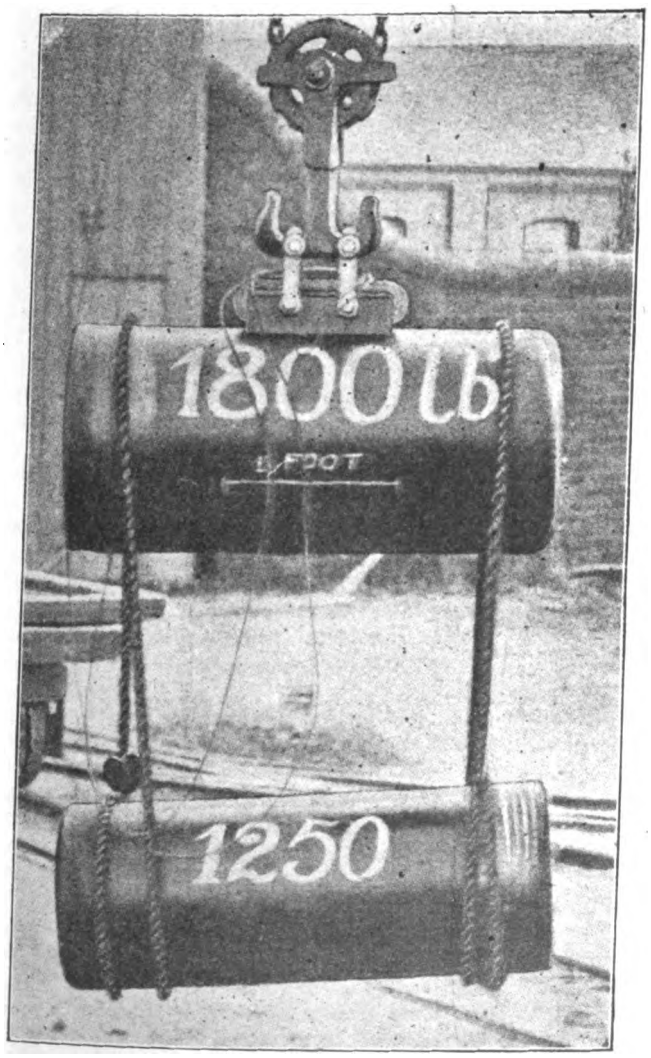
ELECTRO-MAGNETS FOR LIFTING PURPOSES.

An Ingenious Application of Electricity by the English War Department, Described by the London Electrical Review.

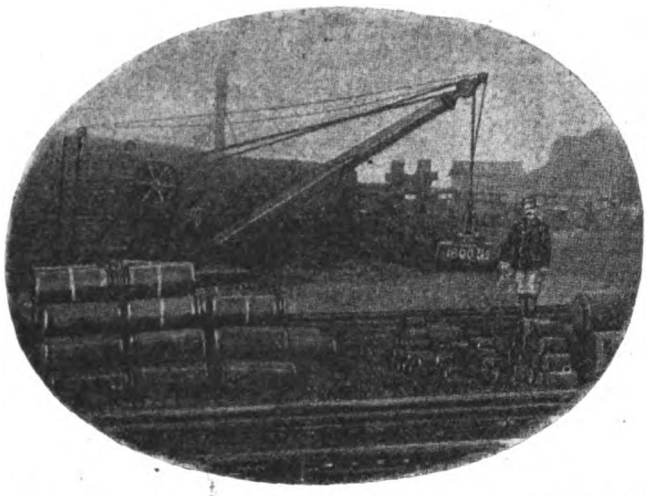
The following particulars and photographs of some electro-magnetic lifting devices, which have been in every day use at the Proof Butts, Royal Arsenal, Woolwich, for the last four years, are published by permission of the Inspector-General of Ordnance.

The magnets in question were designed by Major H. C. L. Holden, R. A., F. R. S., for the special purpose of lifting the shot that are used for proving guns and for ballistic experiments generally. These shot, it will be seen from the photographs, are of special form, having a flat instead of a pointed head in order that their motion may be arrested, as quickly as possible in the sand of the butt into which they are fired. The shot weigh from 1,800 lbs., the weight of the projectile fired from the 110-ton gun, downward to the smallest bores; they are piled one upon another in the stores, and it used to be somewhat laborious work moving them when required, not only on account of their weight, but also on account of the difficulty of getting slings around them. The introduction of the electro-magnet in the place of the slings has made the task easy, and one which is, moreover, quickly performed. The figures require but little



explanation, as they show clearly the construction and method of employment.

The body or core of the magnet is U-shaped and is one forging. The winding is mechanically protected by stout brass flanges and is covered with thick brass strip. The ends of the winding are led to duplicate terminals. Duplicate twin wires, to prevent accidents in the case of the wire fouling and breaking being taken over pulleys to the switch box on the counter-weight at the back of the crane.



A single-pole switch is placed in this box and is used, in conjunction with a water resistance, to shunt the extra current produced on breaking the circuit, to close or open the circuit. The current varies from three to four amperes at twenty to thirty volts, the maximum weight that can be lifted has not been ascertained exactly, but it exceeds 3,600 lbs., as two 1,800 lbs. shot can be lifted, one slung below the other, in the manner shown in the photograph of an 1,800 lbs. and 1,250 lbs. shot being thus lifted. The shot are of hard cast-iron or cast steel, their surface is rough and thickly covered with paint. The weight of the electro-magnet complete is about forty-five lbs.

ELECTROLYTIC PRODUCTION OF ALUMINIUM.

The following figures show the increase in production and the decrease in price of aluminium during the last twelve years. The figures are instructive as showing the immense value of electricity in its commercial aspect:

Year.	Pounds.	Price per Pound.	Total
1884	150	$ 9.00	$ 1,350
1885	283	9.00	2,55
1886	3,000	9.00	27,000
1887	18,000	3.27	59,000
1888	19,000	3.42	65,000
1889	47,468	2.04	97,335
1890	61,281	1.55	61,281
1891	150,000	0 66	100,000
1892	259,000	0.66	172,835
1893	333,629	0.75	266,903

The estimated production for 1894 was about 500,000 lbs. and for 1895 about 2,000,000 lbs.

BIG BUSINESS FOR THE METROPOLITAN.

The Metropolitan Electric Company has been in existence less than two years, yet in one single mail one day last week, President McKinlock received more than two hundred and twenty letters, by far the larger percentage of which contained orders for goods—there being of course a juicy sauce of remittances. One will hardly appreciate what this means, unless he is confronted with a pile of letters up to his neck when he reaches his office in the morning, and even then he must take into consideration the extreme youth of the business receiving this much mail.

President McKinlock and his associates are to be congratulated on their achievement of the past two years.

Send in your subscription to THE ELECTRICAL JOURNAL.

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TELEGRAPH STORAGE PLANTS.

The Western Union Telegraph Company, in the East, has Displaced 21,000 Gravity Cells by Storage Batteries.

One of the first storage battery systems, for telegraphic purposes in the West will be shortly installed in St. Paul, Minn., by the Western Union Telegraph Company. Mr. C. H. Summers, electrician of the company, is now working out the details of the scheme, which will involve the replacing of over 8,000 gravity cells by about 700 storage cells. Owing to the fact that the Western Union may change its quarters in St. Paul and move into another building, Mr. Summers is unable to give any of the details of the proposed change at present. He, however, states that accumulators have been tried extensively by the Western Union in the East, and his company alone has replaced over 21,000 gravity cells by about 3,500 storage cells, whose capacity ranges from six to one hundred ampere-hours. Mr. Summers also says that while the first cost of installing a storage battery plant is equal to the cost of a dynamo and steam plant, the cost of maintenance is much less. The magnificient dynamo plant, described elsewhere in this issue, could be replaced by an equally efficient storage battery plant within the same limits of space and would cost less for maintenance. Mr. Summers admits that the storage battery has had a hard fight, and for a long time electrical engineers regarded it with a feeling akin to suspicion, but he is *quite sure* that it has come to stay.

In installing accumulators in their various offices, the Western Union makes its arrangements to obtain its current for charging purposes with the local central lighting station. In some cases, current is obtained from the lighting plant of the building in which the Telegraph company has quarters, but while this method is convenient, more advantageous terms may sometimes be obtained from some station outside.

ELECTRICAL RESONANCE.

Novel and interesting experiments illustrative of electrical resonance were given by Prof. M. I. Pupin, of Columbia College, in his lecture before the department of electricity of the Brooklyn Institute the other night. In opening his talk Prof. Pupin said that we know the electric current simply by its effects—of its real nature we are ignorant. Its effects are heat, induced magnetism and chemical change. "If we consider the laws that govern electric currents we find that they bear an exact analogy to the laws governing mechanical forces," he said. Three elements must always be reckoned with in mechanical motion. These are friction, inertia reaction and elasticity reaction. Turning to electrical action we are confronted in the same way with the law of electrical resistance reaction, the law of magnetic inertia reaction and the law of electro-elastic resistance reaction.

For every phenomenon of mechanics we have a corresponding phenomenon in electricity. Let us confine ourselves to the analogy between sound vibrations and electrical vibrations. It is well known that piano wires will respond to the notes of the voice with whose pitch they are in unison. If you sing the right note into a bottle of a particular size and shape the bottle will sing it back to you. A small sounding body can start a very much larger body into violent vibration provided the small body has been tuned to the same pitch as the large one. The reason is simple. The vibrations being of the same wave length, the sound wave finds no difficulty in communicating itself to a medium where it can travel unchecked. The pitch of a sounding body depends on its mass and the stiffness of the body. Electrical resonance rests on a similar principle. Every electric circuit has a period. The period is the time required for a current to pass around the circuit, reverse itself and start again. Now, if we adjust the period of the electric motive force, which we employ to the period of our circuit, we shall be able with a small current to set up a powerful electric vibration.

At this point Prof. Pupin called the attention of the audience to a number of circuits arranged by means of wires and coils upon the platform. They were connected with a telephone receiver, in which the electrical vibrations of the circuits set up musical vibrations varying in intensity. At the start the periods of a given circuit and currrnt were made dissimilar. The sound issuing from the receiver sank almost to a whisper. The periods were made to coincide, and the vibrations changed their character, becoming voilent and powerful, while a mighty blast of sound deafened one's ears.

The experiment was then tried another way. The room was darkened and the circuit conneeted with a lighting apparatus. When the periods differed, fhe light was dim; when made coincident there was a strong and glaring illumination. Just as Helmholz discovered that vowel sounds are really complex combinations of different notes, said the speaker, so an electric current generated for practical purposes is made up of several currents united in harmonic combinations. The existence of such combinations Prof. Pupin illustrated by reinforcing a compound current with pure currents corresponding to the different elements in the compound one. At each increase was noted a vast increase in sound. The climax of the evening's experiments was the use of four machines supposed to be located in Buffalo and four others in New York, to demonstrate the passage of four separate currents on a single wire at one time. Each current was of a different periodicity, and the bable of noises they set up in the telephone receiver was sufficient to convince the most skeptical.—*Boston Transcript.*

LIGHTNING ARRESTERS.

A lightning arrester connected in the neighborhood of a motor or generator does not necessarily protect that apparatus. If the insulation of the apparatus be weak or defective, the apparatus is quite as likely to protect the lightning arrester as the lightning arrester is to protect the apparatus. If the lightning arrester is to protect, the insulation must be sound and of a definite strength.

And yet even with the best of insulation a lightning arrester does not always protect. The reason for this is not obvious. That which we see and call a lightning flash is not a simple passage from a cloud to the earth; it is a vibration. The lightning oscillates back and forth. The oscilliatory character of lightning and of disruptive discharges in general, give rise to complicated phenomena. Electric oscillations, or waves, interfere with one another much as water waves do.

If a trough of water be raised at one end and then quickly lowered, the water in the trough will quietly surge back and forth. If the end of the trough be raised a second time, a new system of surging may be started in such a manner that the two will interfere with each other and cause splashing at certain points where crests of the two systems combine to form higher crests. Calm or smooth surfaces will be noticed at points where a crest of one system has been neutralized by a trough of the other system.

In electric wires we have somewhat analagous conditions during thunder storms; we have what a sailor would call a choppy sea. The calm places and splashing places are very close together, so that (and now we come to the point we are looking for) a lightning arrester, for aught we know, may be connected at a calm place or at a splashing place. If at the former, no discharge will take place at the arrester and the apparatus is liable to become damaged. If at the latter, however, a discharge will take place and the apparatus will be protected. But these splashing places are constantly shifting their positions. How, then, is a lightning arrester to be properly located? Answer—By connecting such a number of lightning arresters along the line that several of them are likely to be found at splashing places. Possibly arresters which are at splashing places on one occasion, may or may not be found at such places on some other occasion. The number of arresters should, therefore, be such that for all conditions some of them, at least, will be found at splashing places.—*Cassier's Magazine.*

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ELECTRO-THERAPEUTIC DEPARTMENT.

ECZEMA SUCCESSFULLY TREATED *

Dr. Henry Bordier, of Lyons, France, Describes a Particularly Stubborn Case of Chronic Eczema that Yielded to the Electrostatic Method.

OTHER BENEFITS RESULTED TO THE PATIENT.

Mrs. B., aged twenty-nine years, was sent to me by Dr. Aubert. For nine years, this patient, one of a family of arthritics, has been afflicted with eczema, the principal point of attack of which appeaerd to be the neck. She had several eruptions which had healed up on the application of local treatment, but among the different manifestations there were three which had never yielded to treatment and which appeared to linger with singular tenacity.

One of them, the most important, attacked the left lateral region of the neck beneath the ear. It took the form of a trapezium the superior oblique base of which measured 6 c. m., and the smaller base 2 c. m., with a height of 5½ c. m. It was crossed by a deep wrinkle parallel to the bases of the trapezium.

The second manifestation was situated near the median line of the chest, 2 c. m. below the sterno-clavicular junction. It was oval in form with a length of 3 c. m,, and a width of 2 c. m.

Finally, the third was in the fold of the right groin. These various manifestations had never suppurated; they were formed by a thickening of the skin, which had not the softness of the neighboring parts; the epidermis was thick and scaly. They were the seats of excessive intense prurience which compelled the patient to scratch night and day and this was the dominant symptom. The pigmented surface of the skin gave to the manifestations a very clear outline, and they could be distinguished at quite a distance.

During these nine years, the patient had been treated by several physicians, who had tried various methods without any success. That is to say, that the whole gamut of ordinary therapeutics had been gone through for this chronic eczema, whose rebellious character was evident.

The electrostatic treatment that I applied, was commenced on the 14th of September, and the patient was put in circuit with the positive wet pole, while a pointed electrode with an angle of 96° to the vertical was directed toward the left region of the neck at a distance of about 15 c. m. therefrom; thus a wet positive electrode with a negative breeze.

These treatments were given on the several days following. The first signal amelioration for the patient was the sensible diminunition of the itching in the three eczematous surfaces. About the 15th of October the patient was placed in circuit with the negative pole and the pointed electrode was made positive. Since the 10th of October the treatments have not taken all of two days. The progress toward recovery then began to be marked. The thickness of the epidermis disappeared gradually and the skin tended to return to its normal aspect and color. The itching was less severe and the patient scratched no more at night and scarcely at all during the day.

On the second of November, the mark on the neck could not be readily observed although there were still some few signs in the regions very near the ear. The others have disappeared almost as completely, and no more pruriency can be observed. The treatment was continued until the 16th of November, when the patient was considered as completely cured.

I should like to comment on this method of treatment, introduced in therapeutics by Prof. Doumer, of Lille, and Dr. Monell, of New York. Amelioration in eczema seems to take place markedly as soon as the patient is subjected to the negative influence. This would indicate the employment of this pole hereafter. This, I think, is of some importance, although I have not heretofore advised the use of one pole rather than the other.

It can be well assumed that the constant good effect is due to the wet electrode since the breeze was directed only to the manifestation on the neck. What also goes to prove that this action is indeed Franklinization, is that the patient has received other benefits than the cure of her eczema. Before the treatment, her menses were generally delayed from eight to fifteen days, and lasted scarcely twenty-four hours. Under the influence of the Franklinization they have become regular, and now last for a period of three to four days. Moreover, after each meal, she felt the need of sleep, and little by little the patient has seen this symptom disappear during the treatment. There seems to be no doubt that the static treatment has done much to benefit the general condition of the patient.

Sometimes it appears that the breeze is useful in the sense that it auguments the quantity of electricity that flows away from the body of the patient. The quantity of electricity applied plays a great part in the success of electric treatment in general and in the treatment of eczema in particular, and it is also certain that the power of my static machine (Bonetti) is an important factor in the preceeding good results. In conclusion I will say:

1st. That electrostatic treatment can be used in the treatment of all forms of eczema, and, that the humid form is more rapidly benefited than the dry eczema.

2nd. That the treatment is more rapidly certain in infantile cases than in those of adults.

3rd. In all cases treated by electricity the different manifestations will not reappear when the treatment is continued for a sufficient time.

*Translated from a paper in Archives D'Electricite Medicale.

TREATMENT OF OZENA BY ELECTROLYSIS.

Interstitial Cupric Electrolysis Used in Many Cases With Success and With Regeneration of the Atrophied Mucosa.

It is now three years since we commenced treating our different cases of ozena by cupric electrolysis. We wish to insist only upon those facts which are proven. Some of our patients, who have been cured, remain under regular, periodical observation; there has been no relapse for months, and, in some of the first cases cured, for over three years. We think that no one can accuse us of precipitation in announcing a method of cure for so intractable a disease as ozena.

For interstitial electrolysis are needed:

1. A source of constant electric energy.
2. A milliampere metre that has been tested.
3. A rheostat.
4. Needles insulated by a bit of rubber drainage tube.

A needle of silver or copper is inserted into the mucosa of the middle turbinated bone, through the bone itself or else into its concave surface, which is usually the one affected. A steel needle in the mucosa of the inferior turbinated bone of the same side, placed as nearly as possible between the mucosa and the osseous substance, and extending the whole length of the bone itself, completes the circuit. In those cases where there is a deviation of the septum, we insert our negative needle there.

The nostrils to be operated upon are rendered anesthetic with cocaine, and, as far as possible, aseptic; the needles are made aseptic by heat: the insertion of the needles and the passage of the electric current are both, in the great majority of cases, painless.

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Some patients, however, complain of true hemicrania, or of a dull pain behind the eye, between the eyes, or at the nape of the neck; this may cause congestion of the conjunctiva and lacrymation. These symptoms may persist for several days. In most cases there is no appreciable trouble, but a sense of well-being comes on after the first few days, and with this, as a first symptom, the disappearance of the stench. Rhinoscopic examination shows the entire mucosa of the middle turbinated bone covered with a bluish green layer and the eschar of the lower turbinated bone does not extend to the mucosa. Repair is complete in from 12 to 15 days.

After cure, in recent cases, the mucosa regains all its characteristics; in severe cases a certain amount of atrophy persists. It seems incontestable that interstitial electrolysis, instead of causing atrophy, brings about a regeneration of the athropied mucosa. There were 91 per cent of cures.

ELECTRO-THERAPEUTICS OF THE STOMACH.

Interesting experiments have recently been made, says a writer in L'Electricien, in the application of weak electric currents in the treatment of nervous diseases of the stomach. The current is applied directly to the affected organ by means of a special electrode invented by Dr. Einhorn and modified by Dr. Ewald, which the patient passes into the stomach. The electrode consists of a rubber tube one millimeter in thickness which has at its lower end a perforated vulcanite tip and which contains the conducting wire. This wire does not extend to the capsule, but descends low enough to plunge into the water with which the stomach is filled. After the patient has drunk two glasses of lukewarm water, the electrode is introduced and is attached to the negative pole of the battery. From 15 to 26 milliamperes of current are employed for five minutes. The success of the experiments has been so marked that it seems likely that this method may have a place in the treatment of nervous disorders of the stomach and intestines.

ROENTGEN OUTDONE ALREADY.

Another very remarkable, and at first apparently incredible, application of electricity has been made public. This is neither more nor less than a process for secretly photographing and seeing objects at night or in darkness without the use of the well-known flash light. A singular point in this night photography is that some objects show with less distinctness and others with greater clearness than in daylight. Stranger still is the assertion that some features which are entirely invisible in daylight are disclosed with curious completeness, even in some cases when covered by other substances. The inventor of the system, G. d'Infreville, who is well known in telegraph circles, sees a future for it in naval warfare, among other things. For instance, it would give the ability to follow, with the eye, all the movements of a torpedo boat, and so enable the aiming and firing of guns, the attack or the repulse of the enemy's onset to be timed to the greatest advantage. It is assumed that this process would give advantages in the protection of coasts and harbors against a hostile fleet impossible with the search light, which at once tells the enemy that it is observed, Mr. d'Infreville thinks it will be possible by his process for a man-of war to secretly inspect its surroundings, or a coast or for a fleet to organize a constant and effective, while unsuspected, nightwatch against torpedo-boats or carry on a night bombardment. It should help, on land, a comparatively small body of soldiers in a night attack to overcome a larger body of the enemy not thus equipped. In short, in time of war the possession of this method would give a distinct superiority to the army or navy operating it, all other things being equal. It can be used by policemen, night watchmen and detectives for "shadowing" or photographing persons at night without the knowledge of those under observation. In an article on this subject Mr. d'Infreville reminds the reader that many animals can see in darkness: the cat and others of the feline family, the owl, the bat, and even the horse, to some extent, are examples of it. "Man has already outdone animals in other respects; "why, asks Mr. d'Iefreville, could he not do it also in this one?" The details of the process are not yet announced. It is understood, however, that some of the European governments are now negotiating for its utilization in army and navy work.

A CONVENIENT POLE FINDER.

The trouble brought about by a small thing is very often out of all proportion to apparent significance of the cause. A pole-finding apparatus is a thing not very frequently needed by electrical engineers, but when it is wanted it is wanted very badly. The old and cumbersome devices of polarized voltmeters and electrolyte cells are too awkard and costly to compete with the more recent method of using pole-finding papers. A specially effective form of this handy and necessary addition to the kit of an electrician has been put on the market. The paper is very sensitive and absolutely non-poisonous. Its sphere of utility is not confined to electrical manufacturers of lighting installations, but it will be found of great service to amateurs in all kinds of electrical experimental work. By the employment of one of these "pole-finders," the possibility of wrong connections may be entirely avoided, and such things as reversals of dynamos, motors, accumulators, etc., which are sometimes costly mistakes, are altogether obviated. The paper when moistened and placed across the poles of the dynamo or battery, shows a black mark at the positive pole.

AMERICAN STORAGE BATTERIES IN ENGLAND.

Herbert Lloyd, in a lecture on recent improvement in America and Europe in the storage of electricity, says that the number of storage battery installations being made in England is astonishing. Private house plants, run by gas or gasoline engines are met with everywhere, and central station batteries are going in as fast as central stations are being built. The English have a high appreciation of American batteries, of which they are purchasing large consignments. Hitherto, the running of the storage-battery railroad in Birmingham has given varying results. It is now equipped with American batteries, and the service is much more satisfactory to the public and profitable to the company. A new element termed the expert's "recuperating" has assumed great importance in storage-battery car operation. It is found that a car, while descending a 10 per cent grade, can recover 57 per cent of the energy expended in ascending it; on a 4 per cent grade a return of 42 per cent is effected, and on a 2 per cent grade 23 per cent. The new electric line in the Isle of Man, equipped with a trolley system having a battery in the power-house, has an almost uniform grade of 12 per cent. The car on the trade delivers back to the battery about 23 per cent of the energy it consumes in assension. This means a considerable economy. Great improvements are being made in the casting and recasting of grids, which reduce the first cost and the operation cost of the installation. It is well known that in this country patent litigation has long interferred with the progress of the storage battery. Now the incidential restrictions have in a great measure been removed and the use of the storage battery for traction purposes is rapidly approaching a commercial stage

SULPHUR NOT AN ORIGINAL BODY.

A curious chemical result of experiments made by Strinberg, is that sulphur is only not a simple body, but not even an original one, being simply a common fossil resin or bitumen. He finds that when sulphur is melted at about 120 degrees it disengages an odor of turpentine or camphor, and if a trace of iodine be added, the odor becomes more marked. If it be heated anew between 160 degrees and 200 degrees it looses oxygen and drops to the level of cauotchouc, of which latter it assumes the color and consistency: then, if the brown and viscous liquid which is obtained in this manner be cooled, it preserves its nature for a certain length of time, and then resumes its state of resin.

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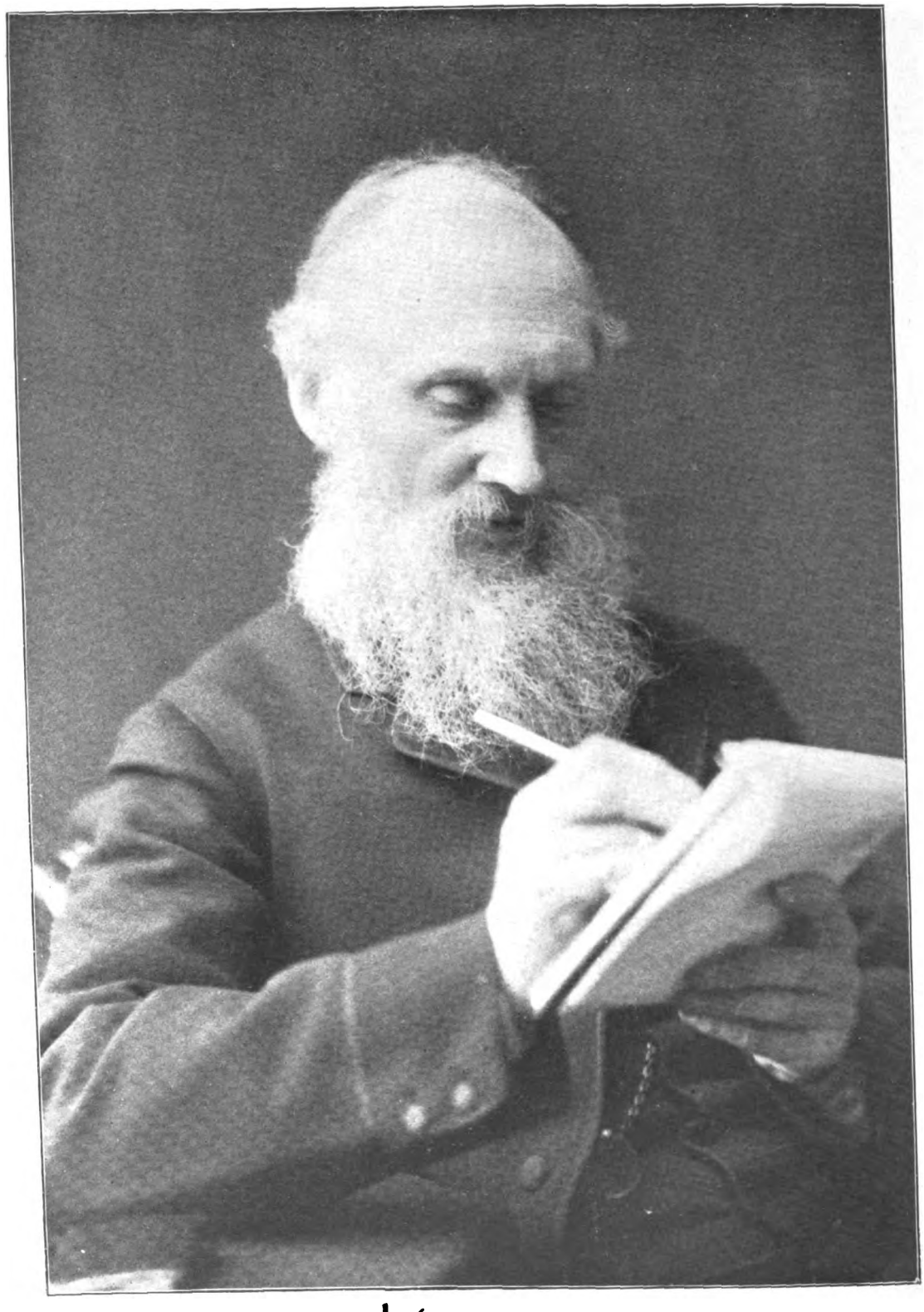

Kelvin

SIR WILLIAM THOMSON (LORD KELVIN.)

Born at Belfast, June, 1824. Eminent Philosopher and Scientist. Professor of Natural Philosophy in Glasgow University since 1846. Designer of Quadrant and Portable Electrometer. Inventor of Mirror Galvanometer and Siphon Recorder for Submarine Telegraphy. Improved the Mariner's Compass.

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The Electrical Journal.

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ELECTRICITY. IN BUILDINGS.

Mr. W. H. Preece Tells Some Interesting Things to a Large Audience, for Some of Which He will be Taken to Task on This Side the Water.

ENGLAND CLAIMS TO BE AHEAD OF AMERICA.

Before a large audience, assembled under the chairmanship of Sir Arthur Arnold, Chairman of the London County Council, recently, Mr. W. H. Preece, Superintendent of Telegraphs and Telephones in the United Kingdom, delivered an address entitled "Electricity in Connection with Building."

Mr. Preece's experience has been so varied and his observation so keen, to say nothing of his delightful way of putting things, that it pleases us to be able to present his address for the benefit of our readers, even at the risk of employing more space on one article than usual.

Mr. Preece said: Sir Arthur Arnold, ladies, and gentlemen—With such a eulogistic introduction I fear that I shall not quite come up to your expectations, for it is indeed an extremely difficult task to address you on such a difficult subject as the application of electricity in connection with building. I do not know quite what you expect me to say. I do not know whether you think that electricity, which is going to do everything in this world, is going to replace bricks and mortar, or whether it is to be utilized as an economizer of labor in lifting materials and in breaking down trades' unions by disestablishing carpenters; but I am going to take this line—that inasmuch as the secrets of good health, apart from personal habits and the correct maintenance and up-keep of the human machine, are pure water to drink, pure food to eat, pure air to breathe, cleanliness in dwellings, in furniture, and in clothing, warmth and light, so I propose to point out to you how electricity in nearly all these points can aid those who desire to support and lengthen life by supplying all the particulars that I have named. Now, legislation enforces sanitation, government inspects food products, it facilitates the supply of water, it controls the manufacture and consumption of gas, and in the same way it controls the supply of electrical energy, and this electrical energy, as well as gas, is utilized not only for the production of light, but for the generation of heat and for the supply of power. In this great city of ours we have two great powers—first, as we are here, I think I will say the Corporation of the City of London; secondly, as we have such a distinguished chairman to-night, I will say, the London County Council; and in these two bodies we have the representatives of all those local authorities who are to be found throughout the whole country; and in their hands Government has placed the control of the different powers for good as I have enumerated. Well, now, have those bodies, as a rule, carried out the functions that the Government have handed over to them? To a great extent they have. But there are instances throughout this country of great backsliding and retardation. In the City, in London, in Greater London, electricity is applied to a certain extent, but nothing compared to what it ought to be, and to what it will be. We are restricted in small communities by various causes, first of which is ignorance, and this, often willful, is frequently due to indifference, and generally due to blindness. I know nothing in my experience more difficult than to try to convince a vestry, or a county council, or a town council with the doctrines of the benefits of electric lighting. I am met on all sides with objections, some due to conservatism—the true conservative is the most difficult gentleman to move; the next most difficult gentleman to move is the radical, because he thinks we are introducing class legislation—he fancies he is asked to do something that is going to benefit the wealthy and aristocratic classes; and the next is the interested individual—the gas shareholder. Now, I find, I am bound to confess, that there is more trouble with that gentleman than any other, and as I am a pretty considerable gas shareholder myself, I have found that my friends the gas companies are terrible people to convince against their will. However, in spite of all this, in spite of the worst of all, and that is party spirit—in every community you have it; you have it in the London County Council, and our own Parliament is divided into two parties—and if one party proposes the introduction of electric light the other party is sure to oppose it, not because there is anything in it, but because the other fellow cannot do that which is right. However, in spite of all this we are going along, and we are going along splendidly. The advance of electrical industries in this country is quite equal to our most sanguine expectations. It is a common thing to find in the press complaints that we in England are far behind anybody else, especially America. That is not my experience. I have visited America many times, and while there is no doubt that in some respects the Americans are very go-ahead, in other respects we in this country are quiet, and we are certain, and we are sure; and in electric lighting in England, as applied where we want it—that is, for private purposes—we are certainly in advance of our cousins on the other side of the Atlantic. Now, the supply of electrical energy in this country rests entirely on two sources—one controlled by private enterprise, and the other in the hands of local authorities. It is a very moot question indeed as to which is the best source or the best means of forcing on this industry. In a pioneer business, such pioneer businesses as I have been associated with—and it is a remarkable fact that in my career I have been associated with the introduction of every single application of electrical energy; I was connected with the early introduction of telegraphy and of telephony, with the electric lighting, with electrical tramways, and with everything else connected with electricity—I find this, that owing to the fact, I am sorry to say, of public companies and private companies having no conscience, pioneer works are best originated and supported and started by private enterprise. When they are well fixed and well established, that is, I think, the time first for the Government to step in, in some industries, and for local authorities to take up the same position. Now, I am sure that the telegraphs would never have acquired their present position if the Government had started the industry. Competition, money-grabbing, and all sorts of causes led to the great development of this industry, and when it became a public necessity, when it became everybody's business, then properly the gov-

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ernment stepped in, absorbed the telegraphs, and took me into their service, and the result of the absorption has been that the telegraphic system of this country is the finest and best in this world. Now that local authorities, too, take over industries for the benefit of the whole community—water supplies, sanitary arrangements, etc.—the supply of light is, I think, the proper function of a local authority. A local authority is bound to look after the health of the community, and anything that adds to the health of the community must necessarily come within their sphere; and so it is that throughout the whole of this country we find our corporations taking up this subject of electric lighting. And what is the result? The result is that the cost of production, which regulates the cost to the consumer; is coming down, and the rate at which the cost of the production is being lowered is quite astonishing to those who are watching carefully the progress of events. Of course, the cost of production regulates the price that the user has to pay. We find in this London of ours that there is great variation in the cost of the supply of electrical energy to the community. Take the city of London. In the city of London—which, unfortunately, from some points of view, is in the hands of a private company—the users have to pay at the rate of 8d. per unit; when you go to one of our outskirts (say, the parish of St. Pancras or the parish of Hampstead), there electrical energy is supplied at the cost of 6d. per unit, so that those who are obtaining their enery under the auspices of local authorities are benefitted in the ratio of 8 to 6.

But, in some places private enterprise produces equally great effects; for instance, in Newcastle, there are two companies competing against each other, and I was quite surprised only last week to receive notices that the rate of 4½d. per unit at which they were supplying current to our postoffice there, and subject to a discount of 10 per cent., was reduced still further by increasing the discount to 20 per cent. The result is that we are paying in Newcastle less than 4d. a unit for exactly the same material, if you can so call it, for which you are paying 8d. per unit. Of course, that is due to the fact that coal is cheap in Newcastle and dear in London. Swansea is a town near the coal district, and Swansea is a town where they have proposed not alone to supply electricity for electric lighting purposes at night, but also to utilize it for working their tramways by day; and if this scheme were carried out (I am not sure that it will be) it would mean this, that by having a continuous supply during fourteen or fifteen hours of the day they would be able to reduce the price to their consumers to probably as low as 3d. a unit. Now, that means that, while 8d. a unit is equivalent to gas at 4s., 6d. a unit is equivalent to gas at 3s., and 3d. a unit means a light equivalent to gas at 1s. 6d. That is probably what would be found in some of those towns in the coal districts which are able to apply their energy, not only for light, but for the movement of trains. I am not speaking idly on the subject, for everybody who wants to know what energy costs and what people pay for it, have only to look every week in the columns of the technical press, and there they will find full records week by week of everything that appertains to the cost of production of electrical energy. One of the first questions asked is, "What is the relative cost of gas and electricity?" I have told you I was a gas shareholder, and I am interested in gas—I do not tell you I am interested in electricity, but I leave you to guess. My experience is, and I have indicated it, that at the present moment, practically there is no difference between the cost of electricity and the cost of gas. Anybody can verify this for himself. If he has not got gas in his house or his office, he has some friend who has, so he has only to compare his electric light bills and his gas bills and he will find whether there is any great difference between the two. Now, I have seen a great many of these accounts, and I have seen great differences between the two. Sometimes the electrical light bill is less than the gas bill—often it is more than the gas, but if you take throughout the country the figures that are published every week, you will find that on the average there is no difference between the price of gas and the price of electricity. That is now. But, as I told you, the cost of production is lowering, and the result will be that the time is not very far distant when electricity will be considerably cheaper than gas. Of course, in my mind, I am comparing the ordinary burner with the ordinary electric lamp. The incandescent gas has recently come in, and that is going to produce a considerable change. There is no doubt that the incandescent gas gives you a very brilliant and a very beautiful light, and I cannot conceive anybody in his common senses who could resist the temptation to replace the old ordinary burner with the new beautiful incandescent lamp. In the first place, it gives a more brilliant light than the old burner; in the second place, it reduces the cost and expenditure; and in the third place, it diminishes considerably the defects of gas, the principal consideration being the freshness of the air we breathe. Many people say—it has been said tonight—that the incandescent gas is going to interfere with the progress of electric light. I do not think so; and I do not think that the introduction of the electric light is going to interfere with the progress of gas. Each has its function. The function of gas is heat and power, not light; the function of electricity is light; and the function of the incandescent gas is to teach the public the benefit of a beautiful light. When they find that this beautiful light carries with it all, or nearly all, the objections of gas, it will mean that their next step will be the displacement of gas in any form for light, and the use of electricity. But gas being in the house, and gas able to be used for heating gas will be applied to heating purposes, and so the business of the gas producer will not be affected, and, which is much more important, the dividends of the gas shareholder are not going to be diminished.

Now, with regard to lamps. One important feature of the electric light is the character of the lamp that is used. There is nothing more simple than the electric lamp. It simply consists of a very fine thread of carbon, which is contained in a glass bulb from which all the air or gas has been extracted. It is, in fact, a vacuum, but there are some remnants of gas left in that vacuum. These remnants are in reality a hydro carbon gas, and in that hydro-carbon gas the filament will remain alight for some time. If this lamp were not a vacuum—if there were air there—the filament would be quickly consumed; the oxygen of the air would combine with the carbon which would generate carbonic acid and the thread would disappear; but being in a vacuum and in a very fine atmosphere of hydro-carbon, the result is that it burns for 1,000 hours or more. It is not combusted; it undergoes a certain disintegration on the surface, and through some electric action the particles of carbon of the thread are scattered and they cover the glass surface of the globe and dull it in course of time. These lamps were for 14 years the property of a company who, owing to the possession of a patent, held the monopoly, and the price charged was a pretty considerable one. The patent has expired and now the manufacture is open to all the world. The result is that we are flooded with lamps—lamps made in Germany as well as lamps made in England, and I think you all know the difference between those two labels. Now they have become cheap, and somebody said the word cheap simply meant the word "nasty." There is no doubt that we have been flooded with lamps that are cheap and nasty; the difficulty is to find out the difference between those that are good, and those that are indifferent, and those that are bad. This is a subject to which I have devoted a great deal of attention. I cannot show you the tests now, but I want to point out to you the general idea of a method by which we can determine the quality of lamps before they are actually used. A lamp is supposed to have a life of 1,000 hours—that is, it ought to have a life of 1,000 hours—but we can in 1,000 seconds let it pass through a certain stage of its existence which, if carefully recorded, will give us the characteristic of the lamp, that will tell us in a few minutes its whole history. I cannot go through the process now because it involves a considerable amount of care, but I will show you what the process is. I switch the

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current on to this lamp and you see it gives the normal quantity of light. I now put on an increased current and this instrument—a voltmeter—indicates the voltage of the current passing through the lamp. You see not only is the brilliancy of the light increasing rapidly, but this indicator shows that the voltage is increasing too. If we had a photometer measuring the light at the same time as we are measuring the current and the E. M. F., we should have all the conditions that determine the life of a lamp. You see what a beautiful thing an electric lamp can be if we could afford to pass through it as much energy as is going through this lamp now. It is an ordinary 10 candle power lamp, and is probably giving 100 candle-power or more. Now it has broken at a voltage of 250. That lamp has passed through a history which, if carefully recorded, will give us all we want to know about that lamp. That is the test we are applying in the post office to all the lamps we can get hold of, and the result is that we shall soon be able to submit to the public a test that will enable us to select the bad from the good and the indifferent from both. Such is the lamp at our disposal for the purpose of introducing light into our buildings, and a lamp that has this particular merit that it does not vitiate the air we breathe. It is a lamp that we can put where we want it; it is a lamp that we can use when we want it; it is a lamp that we can apply to the decoration of our houses; it is a lamp that lends itself to the artistic tastes of the ladies of our households (the most important and particular factor in everybody's household); it is a lamp that gives us light by the consumption of energy without doing any harm whatever; and when we have that energy supplied to our houses at a rate of about half the cost of gas, who is there in this room or in the city of London who will not adopt the electric light in preference to any other?

Well, there are difficulties in the adoption of this light—for instance, the fitting up of our buildings. You cannot bring electricity into a house without there being a certain amount of danger. It is the same with gas, it is the same with fire, it is the same with candles, and it is the same, only much more so, with the common match. However, electricity, being the least dangerous of them all, still possesses danger—danger to person and danger to buildings—and here our Government departments and our insurance offices come in, and they supply us with rules and regulations by which, if we follow them, we ought to possess or obtain in our buildings the greatest possible security both to person and from fire. But, somehow or other, we all of us love, if we possibly can, to do the insurance company and the board of trade, and we want to do things cheaply. We put our work in the hands of the contractor who will do it at the lowest possible price. We do not take the trouble to have our work properly inspected by officers of the insurance companies or by those competent people who are to be obtained all over the country for the small commission on which the poor architect and the carpenter live—namely, 5 per cent. on the work that is carried out. The absence of this inspection has led to a good many troubles. However, notwithstanding all this, the number of accidents in this country is ridiculously small; and of the thousands of fires that take place, the number of fires due to electricity numbers mere units. I think last year it was only three or four throughout the whole country, while the fires from other causes numbered thousands.

The cost of wiring is coming down, and my experience in the post office, where we are wiring up buildings all over the country as fast as we can induce the treasury to give the funds, bears out this statement. In the general post office there are no less than 10,000 lamps supplied and lighted every day by machinery we have in the building. So it is all over the country: Manceester, Leeds, Birmingham, Glasgow, Liverpool, Bristol, and all our great places are being fitted up with the electric light, and we have no difficulty in getting the funds for doing so. Well, now, the cost, as I said before, is going down. At one time the cost of wiring a building was as much as £3 per lamp. I have known it done for less than £1 per lamp; the average is a little more. The cost of wiring depends entirely on taste and on the money expended in fittings. You can spend £50 on a single electrolier for your drawing-room. An electrolier may be made of any form or shape you like, and you can spend as much or as little money on it as you please; and if you are satisfied with plain, simple fittings there ought to be, there is no difficulty in fitting up a building at £1 or £1, 5s. per lamp.

Then comes the mode of distribution. I have a board there which shows how the energy can be distributed through the house. It represents a plan of a house with four rooms, and each room can be put on separately and independently. The one charm of the electric light is, as I said before, that you can put it where you want it. You can use it for any purpose whatsoever, and my friend Mr. Probert, who is here, will show you a doll's house which he has constructed and fitted throughout with electric light. I merely show you that to illustrate how simply electric light can be applied to any purpose. Could you do it with gas, could you do it with candles, or with any other mode of producing illumination excepting electric light? We can also tell exactly the amount of light to be applied to these different purposes. There is an extremely simple law that enables you to determine exactly the number of lamps or the amount of light you want to apply to any particular room or space, and it is simply this—that if you take one square foot of floor surface you want to expend on it an energy of one watt per square foot. A watt means really a measure of the energy that is expended in a lamp. Now, each of these lamps round this room is what is called a 16-candle lamp, and each lamp absorbs 64 watts, There are 746 watts in a horse-power; a horse-power will therefore supply energy for about 11 of these lamps. As each 16-candle lamp absorbs 64 watts, and as a rule in dwelling-rooms you have your lamps fixed about 8 ft. above the floor, a 16-candle lamp will well illuminate 64 square feet. So that if you have a room of whatever size it may be, and you allow one watt per square foot of surface for a lamp 8 ft. high, you have simply to calculate the number of watts for the whole area of the room; and if you cannot put your lamps 8 ft from the floor, but as they are here, about 35 ft. high, you simply have to take the square of the distance and you can calculate to a nicety the amount of light required per square foot. Now, this room as the present moment is not illuminated to one watt per square foot. I know that by the ease or the difficulty with which I can read my own writing on white paper; but there are instruments called photometers that measure with extreme accuracy the illumination of a surface. By following this simple calculation, you are able to determine exactly the number of lamps that can be used and the expenditure of energy they absorb.

But there comes a difficulty; what is the reflective power of your walls? If your walls are painted white, half the number of lamps will give you the same light, but if architects will insist on panelling up their rooms with oak or teak panels, and put up marble pillars and pilasters, put in dark-green wall paper, and decorate their ceilings in a heavy manner, why, then you must expect that the poor electrician will recommend to them a greater consumption of energy. There can be no doubt whatever, from experience, that with light distempered walls, as we are now adopting in our post offices—coloring the ceilings white and the walls as light as they can be—we get twice the amount of light that we should obtain if we were to follow the dictates of some of the æsthetical architects of the present day.

You should put your light so that it shall not offend the eye. The eye is the most wonderful, the most delicate, the most beautiful machine and apparatus that ever was designed or created. If there is anything that settles the point whether the human being is the result of design or of a concatenation of circumstances, as some people assert, the eye with its delicate mechanism is sufficient at once to bring it within the region of design. Automatically, the eye adapts itself to the amount of light that there can be available for it. Our ancestors were perfectly satisfied with the most horrible rush-lights. Nothing

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more appalling than the mode in which our grandfathers lived we in the present day can scarcely conceive. I can remember the time when we had moulded candles, and when the servants came round every hour and snuffed those abominable candles. Our theatres were lighted up by flambeaux. There were great torches suspended at the sides of the stage, and I remember reading of one man who said there was nothing he enjoyed so much in the theater as the smell of the flambeaux.

Now, see what we have got. Look at this hall; and yet I am sure that we see very little better than our great grand-fathers who dined at the Carpenters' Hall, under the influence of a tallow dip, for the simple reason that the eye adapts itself to the amount of light that is available for it. And that is why it is the greatest mistake in the world to place with the reach of the eye the bright and brilliant thread of one of these electric lamps. It dulls the eye. If you come into a lighted room from the bright sunshine it looks dull, because the pupils of the eye are expanded by the brilliancy outside, and so it is that one has to study the eye in arranging the decoration of a room. The first law is, never let the eye be offended by the brilliancy of the incandescent carbon fillament." This is carried out to a large extent in nearly all our buildings. There is one of the banks in the city of London during the last week which has been lighted, not by the direct light from the lamps, but by reflected light of white walls, and I am told the effect is very beautiful.

So much for electric light. That is not the only purpose to which electricity can be applied. Electricity generates light because it generates heat. The only reason why these lamps show light so brilliantly is because they are heated to great brilliancy. The current passing first of all produces heat before it produces light. It is now being used to a very large extent for other purposes. Here is what is called a radiator. I happen to have in the post office a rather large room, and I found that my single fire-place during the cold weather was not sufficient to maintain the temperature of the room, so I had one of these radiators. The current passes through a wire that is behind the metal screen and becomes heated; not so hot as to become light, but quite hot enough to radiate heat, and the heat generated by the radiator is quite sufficient to raise the temperature in my office from 54 degrees to 60 degrees, and it maintains the temperature of my office constant; so electricity can be applied to warming one's apartments. It can also be applied to boiling water. Here is a small kettle; I simply attach the block to the contrivance, and in about ten minutes the water will boil. To be exact, it is worth knowing that it takes just twelve minutes to boil a pint of water, and it costs, with your energy at 6d. a unit, a farthing. Here is also an egg-boiler; but not only can you use electricity for making tea, for boiling water, for cooking steaks, chops, sausages, and all that sort of thing, but you can use it for no end of purposes—curling-tongs, flat-irons, and so on. We use it in the post office for heating up our wax. The quantity of sealing-wax used in a post office is marvellous; I cannot tell you how many tons are used per annum, but the consumption of gas and firing to maintain the heat to melt this wax is very considerable, and now, in Leeds, we have introduced electricity for the purpose so far with success.

We can also use this energy for producing power to produce motion in machinery; and one of the most useful purposes in hot countries or in warm weather is to move fans, or in India for moving the punkahs. In engine-rooms and workshops fans not only produce great circulation of the air, but extract the air also and maintain ventilation. Then, again, it can be used for working pumps, and it is used for working lifts. In London there is one near Bond street, close to the electric light station, there is one in Brighton Town Hall, and in several other places there are lifts worked by electricity. We are introducing the current for lifts at our post office in Leeds. You can use it for knife-cleaning, it is used a great deal for printing machinery, and there is a very ingenious thing, one of the latest developments invented—viz., a deck-planing machine. What with its ability to supply us with the purest and cleanest light, with the means it gives us to warm up our buildings and to supply us with means of cooking and looking after our creature comforts, what with its power to enable us to ventilate our chambers and to cool the atmosphere in heated climes, I think we must say that electricity possesses a superiority over all other forms of energy. In dwelling-houses, in offices, it adds to the health of our people, in shops it is almost imperative, in workshops it is the greatest comfort in the world to the worker—it improves his health and enables you to get more work out of him—and in theatres and places of amusement it enables everybody to go with comfort to himself and to everybody else. In the days of gas a visit to the theatre invariably resulted in a headache; now, with the electric light nothing of the kind occurs.

When you look at some of the pictures of the past—only two or three years ago there was a picture in the Royal Academy of a Highland chief keeping his court in his house, supported on each side by stalwart servitors holding torches, the floor covered with heather, and there he and his attendants sat at dinner. Compare the position of the Highland chief and people of rank in the olden times, with their stinking, flaring torches, with the comfortable bourgeois of the present day in his suburban residence, whose rooms are clothed with elegant Turkish and Oriental carpets, whose walls are decorated with the highest efforts of art, and whose living-rooms and bed-rooms are lighted with the purest and most simple form of light. So we come to the conclusion at any rate, however well our great-grandfathers saw, we see with ten thousand times greater comfort; and we have succeeded by admitting these forms of energy into our premises in doing something that has added to the happiness and to the comfort of us all.

MAKING PENITENTIARY CANDIDATES.

Brother McCullough of the *St. Louis Globe-Democrat* would probably claim to be an honest man, but he is certainly putting it into people's heads to steal. He is however, mistaken in thinking the theft of the electric current is not punishable. A man in Tennessee recently indicted by the grand jury and convicted, could tell the *Globe-Democrat* several things it doesn't seem to know. At any rate here is what the *Globe-Democrat* has to say on the subject of stealing the electric current:

Many electric power stations are greatly exercised over the fact that not a few of the business houses and manufacturing places in their vicinity obtain their electricity for light and power purposes without paying for it. The free discussion of the way in which the pipes running under many city streets have been honeycomed and destroyed by the electrolytic action of the stray currents from trolley lines has taught the public that where electric roads are operated there is plenty of current, as it were, lying around loose, and the next idea that naturally presents itself is to turn it to account. Any electrician can, for a few dollars, make the required connection, and the electric companies have no case against the man who does it. It is not like tapping a gas main, for the electricity is taken from the ground, and not from the company's wires. All along the line of electric roads in large cities are numberless pipes, which, being good conductors, are sought by the stray electricity. Water pipes are particularly susceptible, as water itself is a good conductor. To utilize the current it is only necessary to attach wires to a motor, and a very efficient power is obtained without expense. It is also said that a great deal of private lighting is never paid for, and owes its existence to this deflected electricity.

X RAYS WERE KNOWN IN INDIA.

Dinshar Pestonjee Ghadially, known India as the "Parsee Edison," late electrician to his highness Mabaraj Rana Sahib of Dholpur, central India, and also late telephone superintendent of Dholpur state, is in the United States on his way around the world. Dinshar is a theosophist and claims that the X rays were long known to his cult representing the psychic forces at work in the universe.

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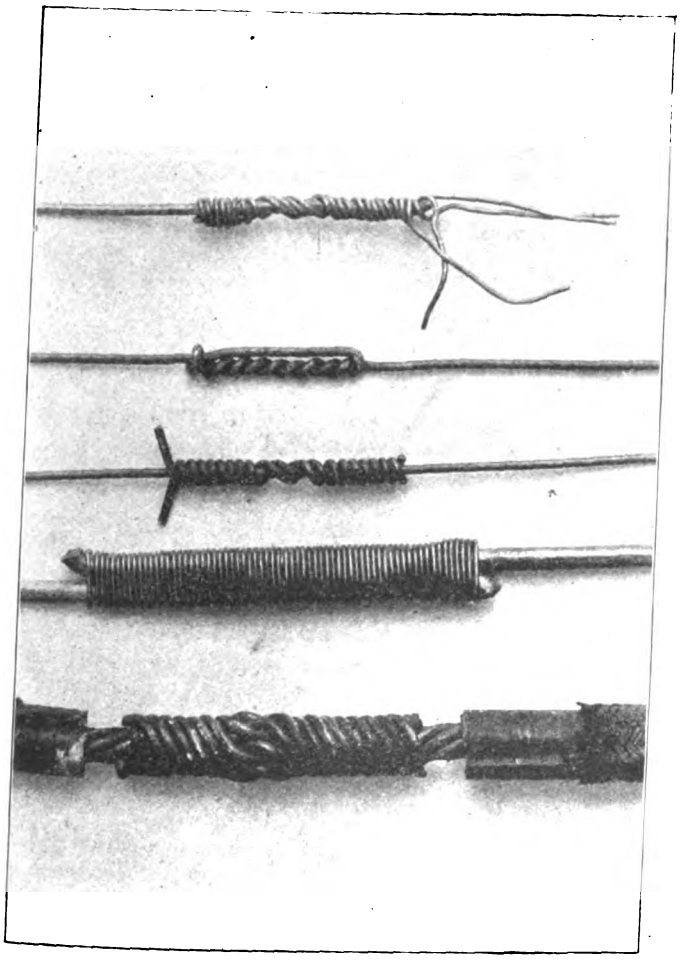
PERFECTION IN WIRE JOINTS.*

Faulty Workmanship in Wiring is Responsible for a Great Many Undetectable Leaks of Current, Which Mean Loss to the Central Stations.

MUST BE MOISTURE PROOF AND INSULATED.

A certain philosopher once made the remark that if we take care of the cents, the dollars will take care of themselves. If, in this life we look sharp after small leaks, the larger ones will never exist, is as true of electricity, as Franklin's proverb is of money. The small things in our calling—whatever that line of life may be—are apt to be overlooked while we are searching for some ponderous or wonderful fact or result, until experience has taught us that giant strides are few and rare, while everyday little happenings for good or evil, are right to our hands, for acceptance or refusal, for weal or for woe. There are many such little affairs in the electrical line, from which I have selected one, in which I trust you may be somewhat interested—wire joints.



SAMPLES OF GOOD WIRING.

There is a law which is one of the fundamentals in electrical practice, that you are all familiar with, which, expressed as a formula, is written C equals E over R. The current from any source of electricity, when sent over a conductor, will be equal to the original pressure, divided by the obstructions, the resistance, which opposes flow of current. C in the equation is current flow, E the electro-motive force of the origin of electrical power, and R the resistance.

This resistance is rather difficult of explanation by comparison, because it is unlike everything else. It has been compared to friction, but this gives me a very inadequate idea, when I consider that we can neither see or know electricity except through its effects. We can understand friction when we draw a heavy article over a rough surface, or force a fluid through a rough pipe, and a smooth one of similar dimensions and character and compare them. But here is nothing of that character, and yet an opposition interferes with the electrical result which we call the flow of current, and may be caused by either:

1st. Insufficient size in a good conductor, or

2nd. A large conductor of inferior, or poor carrying capacity.

The first of these, good conductors, includes the various metals, the best of which are silver and copper, and other metals following until a very poor conductor is found in many of the impure metals, oxides, etc., acids, charcoal, plumbago, moist earth, impure water, etc., are also conductors.

In the second rank are found partial conductors, dry wood, lime, marble, camphor gum, paper, etc. There is no such thing as a perfect insulator. An application of the principle of ohm's law, can be made to show that a large amount of mischief may be lurking in one or more imperfect joinings of a wire. Whether a joint is perfect or imperfect, in the case of electric lighting may mean much money protected or lost. During my experience with electric light people in Chicago, I have repeatedly met persons who claimed to know a deal more about electricity than I dared assume, who were ready at the drop of a hat to take up the cudgel in the cause of joints without any solder, and with as little mechanical protection as possible. A case in point—a place of entertainment in an Eastern city was burned a few years since, which was on investigation quite positively shown to have been caused by a badly made connection.

The object of a joint is to furnish a conductor of equal capacity with the two portions of the line which it joins. If I wrap a round wire around another round wire, it is easy to see that the contact between the two is only a line of extremely small surface of the length of the twisted portion. An old, weather-beaten joint, when untwisted, shows this line perfectly. A section through such a connection will look like a lot of shot lying touching each other. This, of course, supposes the joint to be properly made, according to the best authorities.

I found too that this class of electricians either could not, or would not make the joint after a proper model.

Let us see what a proper model joint is:

1st. The American or telegraph joint—misnamed the Western Union joint. It existed, and was a joint of excellent reputation before the Western Union was born, or Chicago had heard the click of a telegraph instrument.

2nd. The three wire or long distance joint.

3rd. The Brittania or English joint.

These are some of the simplest acceptable connections, and when properly made, with turns enough, and then soldered, and properly protected from the weather, by a water-proof covering of tape, are good for the purpose.

In all forms of connection, splices, branches, and the like, two or three essentials should never be overlooked. The first thing to be done is to thoroughly clean the wires. If it has an oxydized or rusted surface, if it is an insulated wire to which the rubber or gum adheres, if it is a paraffined wire, the parts which are to be put together to form the connection, should be thoroughly brightened. This is best accomplished by scraping with a knife or some sharp edged scraper. Sandpaper or emery cloth will brighten it, but there may possibly remain, unless it is carefully wiped off afterward, particles of glass from the sandpaper, or grains of emery from the emery cloth, which two substances are insulators, and for minor currents, like those from batteries, for telegraph, telephone or signal purposes, may introduce a troublesome difficulty in a line. A resistance may effectually stop a feeble current. The second move to be made consists in winding a firm, close connection in the form of a joint, bringing the polished surfaces together in a sufficient

*Address recently made before the Laboratory Class of the National School of Electricity by C. C. Haskins, Electrical Inspector of the City of Chicago.

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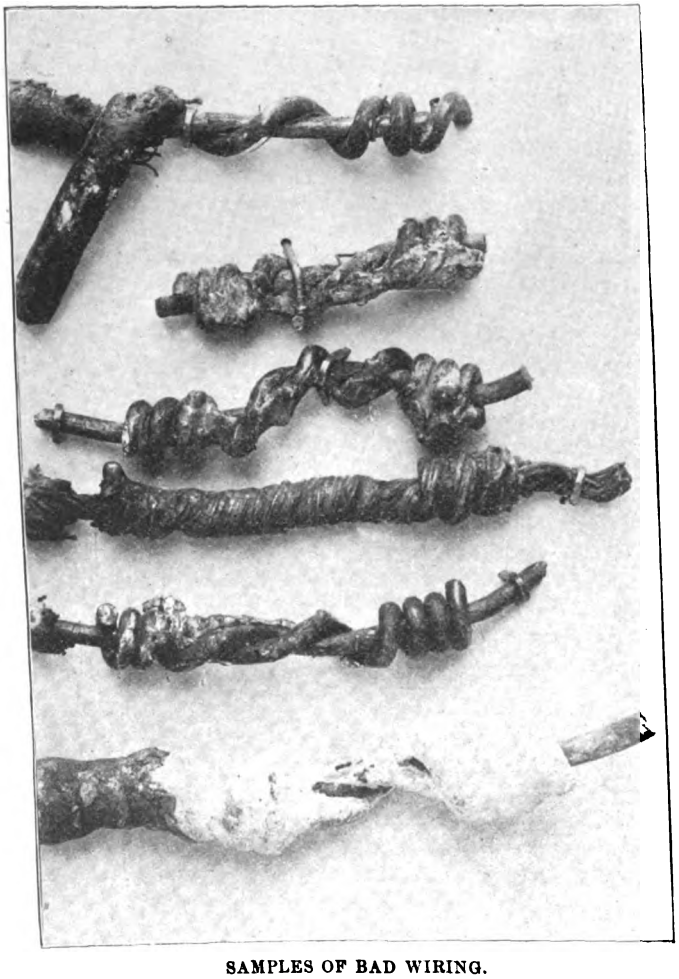
extent to give not only strength, but ample conductivity, otherwise the joint may be weak, both mechanically and electrically. Thirdly, I hold that all electrical joints should be soldered, for two purposes. In the first place it strengthens the connection, and secondly it fills up the gaps between the two wires, and between the spirals or turns of each of them. The surface contact is thus very largely increased, and the carrying capacity is greatly augmented.

The soldering of a joint, judging from some samples I have seen taken from electric lighting plants and telegraph lines occasionally, is not thoroughly understood by the lay brethren. In the first place the soldering fluid or the resin or wax used, refuses to do its work unless the cleaning of which I just spoke has been thoroughly done. It is useless to attempt to do a nice piece of work unless there is a proper heat. If the soldering bolt is used it should be thoroughly tinned, and quite hot, especially if the joint is to be made in a large wire, and we must not forget that the wire, copper, or iron, must be tinned before solder will adhere to it, and close the openings. Where the



SAMPLES OF BAD WIRING.

blow pipe can be used, the work is easier. In all cases the superfluous solder should be jarred off the joint. The next move to be made is to clean off the joint, to rid it of the acid. The reason of this you will readily see, when you remember that you have there two metallic substances, copper and solder. Now, with the acid on the surface of these, you have all the elements of a perfect battery. The action of a battery you know, tends to destroy one of the two metals—but for the dissolving of a metal there would be no current.

I have found acid on a joint months after the connection had been made, and I have repeatedly found joints almost eaten off by the battery action, where the line was partially protected from the elements.

Having gone thus far with the joint, the rest of the operation may, under some circumstances, be omitted; but, if we are handling insulated wire, then the joint should be as well insulated as the rest of the line, if anything we should try to make it a little better. The next move then, after thoroughly cleaning and drying the connection, is to cover it. All good wires of today, have an outside covering of braid or tape, which is put there for mechanical protection. This braid or tape is made of cotton fibre, and dipped, soaked or boiled in some tarry substance—mostly coal tar, asphaltum, or some similar product of bituminous distillation, which is insoluble in water, but which renders the cotton only partially so. As proof of this I may relate an instance.

In a certain factory of insulated cables in an Eastern state, the question of whether a cable surrounded by fibre soaked in such a moisture repellant as I have spoken of, would absorb moisture or not, resulted in an experiment. One hundred and thirty feet of lead-covered cable, consisting of a wire surrounded by fibre well soaked in paraffine, was laid along the floor, both ends being open, one end buried in a pail of water standing on a chair, which gave the water a head of about twenty or twenty-four inches. In four days a test showed moisture at the farther end of the cable.

Now for the application. This outside covering will carry moisture—lengthwise—as well as, if not better than crosswise. If then the least thread of this outside fibre touches the naked copper, it will sooner or later ground the line. Hence, we must arrange to prevent this contact.

A section of the wire shows the copper, the rubber covering or insulation, the mechanical protection, braid or tape.

Now we cut down to the wire, baring enough of the two pieces of wire to make the joint. Then, going back farther, we cut the braid so as to leave a fair length of the insulator, being sure not to permit any shreds of fibre. Now we have three sections: Wire, rubber, braid. If, now, we fill in over the joint with a waterproof substance, like rubber tape, and carry this wrapping over the rubber insulation, we will shut out the moisture, and when we have covered the whole with a tape from back of the cuts in the outer covering, we shall have a joint that will be water and damp proof.

Joints made in cables, especially those which are covered with lead, require still more care. The lead is always a ground sooner or later—generally before there is a current through it. Every particle of moisture should be dried out of it, before closing in, and a sleeve or sweated joint should cover the whole. This is not easy to accomplish, is usually the work of an expert, and trenches largely on the plumber and gas fitters' trade. I shall refer to this again.

As I before remarked, there may be cases where dry naked wire may need no covering. But in these days of electric light and power, where currents used are capable of illuminating our skyscrapers and elegant residences from top to bottom, and running all sorts of machinery and street cars, experience has shown that the wires formerly used for bells, for signals, for time distribution and for telephone service, private telegraph and burglar alarms, will answer no longer. All these conveyors of pigmy electric forces have to step down and out, in the presence of the giant which handles a street car or lights up miles of boulevard, or hide behind an insulation which insures their well-being. Consequently the old styles of office and annunciator wires, the paraffine insulated wires, are rapidly disappearing, and with them the fire hazard which their use courted. Even the door bell wire should be of some water proof insulated variety, and the joints covered, so that in case of accidental contact, mischief cannot occur through a cross.

It may be asked why, when an elcetric light or power plant is required by law to be well insulated, should there be any objection to a naked door bell wire, which doesn't have more electricity than it gets from two or three jars?

1st. For the reason that if there is a possibility of a mishap, there is always danger.

2nd. Because the unexpected always happens. Artemus Ward said there are two things in this world we are never pre-

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pared for. One of these is twins. If he were alive today I think he would say the other was an electric fire.

3rd. Because however careful owners and patrons of electric light and power lines may be, and however well built and tested the lines are, a lurking danger is aided too often in making mischief through either of the above wires carrying insignificant currents; old dead or abandoned wires have often caused material damage, and

4th. Because in electric work the best is none too good.

My motto has always been 'fix it so it can not,' and it will not.

I hope I may not be accused of straying from my text. This has all more or less a direct bearing on the point at issue.

I shall show you several forms of joints for various purposes, some of which are more fanciful than necessary. Among them there are several, in fact nearly all, which would be acceptable, if properly soldered and covered.

These will remain on the table after the paper for your inspection.

There is one point, which is essential, and of vital importance which I desire to dwell upon, in connection with joints and wires. Every wire of whatever size, has a specific carrying capacity which is safe, and beyond which the safety line is left behind—in other words when the carrying capacity of a wire is below that required for the current it should carry, the result, as you know, is heat, proportioned to the deficiency. If a wire of a given capacity, say a number six, has all the current it can safely carry, and we cut that wire and put in a piece of a smaller size, say a number ten, twelve or fourteen, we will find that the small wire heats up at once, and the smaller its guage, the hotter it will get. The resistance cuts down the flow, and developes it in heat.

The resistance of a switch contact, if there is too little touching surface will accomplish the same result.

And the joint. Abnormal resistance in the joint because of want of perfect metallic contact will give us the same result. Resistance means heat in a direct ratio; heat means fire when we get enough of it, and electric fires mean black eyes for the electricians.

The resistance of joints which are poorly constructed, has been the cause of money losses in other ways, also.

In the first days of the inspection bureau, I found that at almost every working plant there was most profound ignorance on the subject of joints, and the bell hanger variety was nearly everywhere to be found.

On one occasion, where the resistanee of the line of a central plant was eight or ten times what it should be, the sixty light arc machine was only lighting about 28 lamps fairly well. I was appealed to for help, and diagonising the case, I soon found the fault and prescribed the remedy. With the help of one man for ten days, we brought the line up to its original capacity. The joints in it were all bad, and numbered over 150. They were none of them soldered. There were in addition two or three ground leaks, but the principal difficulty lay in the joints, some of which were thimble connectors—a form little used now, although then quite common.

Another case not dissimilar was developed in Chicago. On examining the plant I found certain changes necessary, and suggested them, and the proprietor, after fighting stubbornly against the repairs, grumblingly submitted. The symptoms were bad, loose joints, several sections of a smaller wire, and more or less leaks.

The electrician, who was believed by his employer, having done all the work himself, sided with my opponent, but was finally ordered to make the changes. In a few days after the certificate was issued, I learned from the owner of the plant that the dynamo was doing better work with less revolutions, and that the saving in coal would pay the inspection fee in two or three months.

The amount of resistance which a full-fledged well-rusted joint will interpose in a line is something remarkable. As an endorsement of this statement I may say that for several years the electrical department of this city had a collection of high resistance joints taken from working lines. Some of these measured 2,000, 2,800, 4,000, and one 20,000 ohms.

The ideal joint, if we could have it, would be one in which there would be but one metal, so that electrolysis would be impossible, and one into which no moisture could work its way between the wires. Such a one can be, and is made in the majority of underground work. It can only be done by an expert. The wire is thoroughly cleaned—the bare hand should hardly touch it, after it is ready for covering. Heat is applied until every particle of moisture is driven off. The joint is not soldered, but covered properly, the outside sleeve brought over the opening, and finished with a wiped joint which prevents the ingress of moisture, so that the wire remains permanently dry.

It is easy to see that it would be suicidal to permit of unsoldered joints in ordinary practice, made by the average workman. We require the soldered joint—not because it is radically the best, but because it is the very best we can do, under the circumstances.

Among the joints to which I wish to direct your attention are some forms which have virtually dropped out of this market, and some others which are still struggling for favorable recognition. The former of these are called connectors, and their use furnishes excellent facilities for electrolysis. Placed on a copper wire we have copper, brass—zinc and copper alloy—and iron screws. The contact too, is deficient, so that a line of wire with these connectors generously distributed along its length would call for additional power over what would be necessary, under more favorable circumstances, whether it was to be used for power, lighting, telegraphy or almost any other application of electricity. They were invented to do away with soldering. Additional power will overcome the obstruction; but power costs money. It used to be no uncommon thing in the early days of telegraphing to work easier in a rain storm than in dry weather, and with less battery, too, because the joints were better conductors when wet. They were not soldered and filled with dust.

To conclude—During my first years as a telegraph operator, I started one morning for a break between Lewiston and Lockport. Between the two towns was an Indian village. One of the good inhabitants had pulled the bent ends of the wire as near together as he could and tied them with a string, and I must say that this was decidedly the worst wire joint that I ever had the pleasure of inspecting.

STORAGE BATTERY ECONOMY.

The economy and efficiency of storage batteries in all kinds of electrical works is beginning to receive the attention that the subject really deserves.

Papers bearing on the question which would fill volumes have been written and read before various electrical associations, but the "seed" has apparently fallen on barren ground. The statements of electrical engineers of the highest reputation have been received with polite credulity and with subsequent indifference.

The theoretical and practical experience of foreign engineers has been ignored until close competition has compelled attention to the subject, and this general awakening to the importance of the matter is beginning to be generally felt. As usual, the large corporations are the first to take hold of the matter, and it is a subject for congratulation, that having recognized that the use of storage batteries was an imperative necessity, they have spared neither pains nor expense in putting them into service.

Elsewhere is given an account of the adoption of storage batteries by the Western Union Telegraph Company, and the officials of the company do not hesitate to say that there is much economy in their use.

Statistics are also given showing that other large corporations are recognizing the value of the accumulator and are using it.

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TROLLEY WIRE CUT-OUT.

A Device By Which a Section of Road May Be Cut Out of Circuit for Protection of Firemen.

Letters patent were issued on March 3rd last, to John P. Barrett, City Electrician of Chicago, for "A Trolley Protector for Firemen." In all cases of fire where trolley wires run in the vicinity of the conflagration the lives of firemen and others are endangered, and prudence dictates that the current should be shut off. To telephone to the power station and have the machinery shut down, entails the loss of valuable time, or the cutting of the live trolley wire is always attended with great risk.

To obviate these disadvantages, Mr. Barrett has designed a protector by the use of which a section of the trolley may be cut out or rendered inactive without the necessity of cutting the wire or telephoning to the power plant.

The protector is in the form of a support which may be inserted between the trolley wire and the track with device to make a good electrical contact between both of these. Two of these are used, one on each end of the section that must be made inert. When placed in position they make a short circuit on the line which may blow out the fuse or operate the automatic cut-out or the support may act to shunt such proportion of the current as to render the section of the conductor in the vicinity of the fire, safe to handle. The path through the support may thus, instead of short-circuiting the generators or blowing the fuse, afford a path for the current of such resistance relatively to the resistance of the human body, that the current passing through the body of a person coming in contact with the trolley wire would not be of sufficient strength to endanger life.

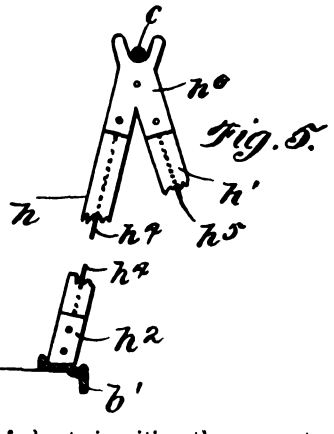

Fig. 5.

The device will be warmly welcomed by transportation companies, for, unless the trolley wire should be wrecked by falling walls, or some other such accident, it will do away with a considerable item of expense for the repairs which must generally be made.

NO SCORCHING ALLOWED IN ENGLAND.

An American engineer on a tour of inspection in England says that nothing more emphatically demonstrates the contrast in ideas and temperament between people of the "old country" and those of the United States than the requirements, government and otherwise, as to the speed of public conveyances. In England the lumbering omnibus potters along at its six miles an hour, while the horse-car is, if anything, slower still. Eight miles an hour is considered almost "scorching," and the conviction of a driver for traveling at such a wild and unheard of pace at the time of a collision or other accident would probably entail serious consequences to himself and his employers. Ten miles an hour is furious driving, and would justify the interference of the nearest policeman, with an inevitable fine to follow. These facts are contrasted with the performance of the electric line just opened between Detroit and Mount Clemens, Mich. The road is fifteen and a half miles long, straight and level. The schedule rate for the whole distance is twenty miles an hour; that maintained between stops often runs as high as thirty miles an hour. The fare for the whole journey is 25 cents, and the cars are spacious and luxurious.

RACINE TO HAVE A CITY ELECTRICIAN.

Racine has an ordinance under consideration to provide for a city electrician. The duties of the officer will be many, and provide, among other things, for complete control of all electrical wires, poles and apparatus in the city. He shall be appointed by the mayor and hold office for one year. His compensation shall not exceed $1,500 per annum. He shall have charge of all ordinances now in force relating to electricity, and all ordinances that may hereafter be placed upon the statute books. Any company or person wishing to string wires, must first be provided with a certificate from the electrician and there can be no change of wires without first notifying that official. He has the power to inspect all wires, lamps, motors, etc.

Embodied in the ordinance are clauses providing for the payment of fees by all consumers of electricity. On fifteen incandescent lamps or less there is a charge of a dollar a year and the fees gradually advance in comparison with the number of lights used. On arc lamps there is a charge of $1 a year each and owners of electric motors are also taxed from $1 to $5, according to the number of horse power used. Any person violating any provisions of the ordinance is liable to a fine of not less than $10 or more than $50. By levying a tax, it is thought that the office can be partly or perhaps wholly self-sustaining.

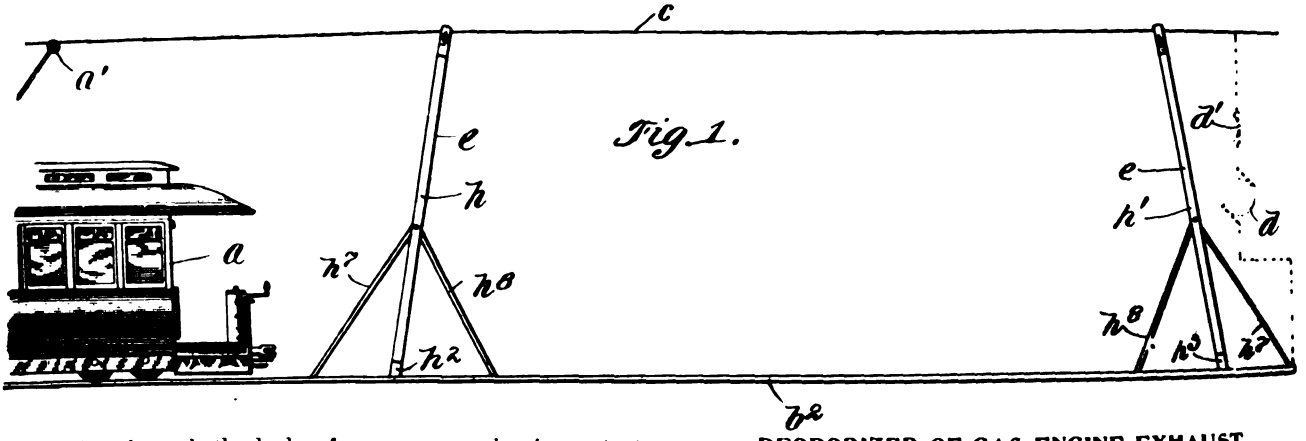

Fig. 1.

DEODORIZER OF GAS ENGINE EXHAUST.

A device for deodorizing gas engine exhaust is described in the *Chemical Trades' Journal* as consisting of a box divided into two compartments by a perforated partition, on which bone black is spread in a moderately thick layer. The exhaust gases from the engine enter into the lower compartment at the extreme left, pass through the perforated dividing wall and superimposed layer of absorbent in the upper compartment, and thence escape into the open air through a pipe at the upper right-hand side. Thus the ammonia and fœtid hydrocarbon gases are absorbed by the bone black, and whatever liquid offensive particles may be in the products of combustion are retained by it mechanically. Water of condensation collecting in the lower compartment may be drained off through a drip pipe.

Columbus, Ohio, is to have a municipal lighting plant.

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EYE SIGHT FOLLOWS THE X RAYS.

Mr. Edison Views the Human Interior Anatomy Without the Aid of Photography, and Instantaneously.

VAST STRIDE FOR THE SCIENCE OF MEDICINE.

The daily papers are publishing some marvellous discoveries by means of the Roentgen rays, but the wildest fancy is hardly ready to follow the New York *Journal* in its description of Mr. Edison's work. That paper says that Mr. Edison, last Friday, succeeded in penetrating the human body with the naked eye. He looked into the heart and lungs, and examined the arteries, the blood vessels and muscles of one of his assistants. Mr. Edison has perhaps, reached the crowning glory of his life—he has opened the door which at once revolutionizes and incalculably widens the horizon of the medical world.

The great inventor has laid bare to the eye of the physician and the surgeon every organ and tissue and bone of the human body. The simplest mind can grasp what this means in the diagnosis, the treatment and the actual observation of the progress of internal diseases. It is very simple to Mr. Edison. With the powerful cathode light behind his patient, he gazes through a screen of prepared chemicals and sees every organ of the body as plainly as he sees the dishes on his dinner table.

Mr. Edison is now completing a fluorescent screen eight feet high, which will enable him to see these things from the top of one's head to the sole of his feet. The fluorescen substance used by Mr. Edison, and declared by him to be the most powerful thing of the kind discovered so far, is tungstate of calcium—in other words, tungstate of lime. The two substances are fused in a furnace and at a proper degree of heat form little crystals perhaps one-eighth the size of a French pea. These crystals are glued to a piece of paper by means of collodion, a transparent celluloid paint. In the case of the huge screen that Mr. Edison is building for taking at a glance the entire internal organism of a man the crystals would be spread directly on an inch plank.

The screen is made in the shape of a monster mill hopper, standing on end. The face on which the crystals are applied is about eight feet high and four feet broad. To this face will be fastened sides that will slant inward to a sharp point. At this point there will be left a slit just large enough to see through with ease. This slit will be protected by means of a rubber flap in such a way as to exclude all light when the eye is applied to it. The screen will be set up so that the side on which the tungstate of calcium has been glued faces a row of four or five Crookes tubes, set one above the other, at an equal distance. The person to be examined will then step in between the screen and the light, and he will be instantly penetrated and become visible to the eyes of the examiner at the screen.

"But if you penetrate the bones of the skull will there be anything at all left to see? Will not a man dissolve into thin air and leave no impression?" was asked.

"We now have perfected our screen to such an extent," he replied, "that we can go through bone when we get the proper light about as well as we can go through some other substances. Of course, under these circumstances, when we get our current and lamps just right, we will be able to look through a man, leaving nothing to be seen, unless indeed, there are foreign substances, like metals, which do not absorb the rays. When we are looking for such foreign substances we will use the full power and leave only a vague shadow outline of the bones. But in ordinary cases, where we do not want as much strength as that, we will see just as much or just as little as we desire by changing our focus."

Mr. Edison had run out for a few moments from the dark room in which he was experimenting and was searching for a new chemical that was to be used in the test. He got what he wanted, and, after watching the X rays come up and die down and come up again in the Crookes tubes that were on the pumps for exhaustion, he said: "Now, there you are. Turn on the current, Brown," to his assistant. "That looks perfect doesn't it? As far as we can see we have there the X ray; the same condition that exists when we get out our best results. That's what is confusing; for when you take this screen and look through it everything is pitch dark—perfectly black. Try it yourself." The wizard handed the reporter the screen, which is a miniature of the big screen which he proposes to use for his life-size examination. It looked not unlike the hopper of a small cider mill.

"That," explained Mr. Edison, as he passed the screen along, "is the most familiar form in which to get up the screen for experimental work."

What would have been the open end of the hopper in a cider mill was covered with glazed pasteboard, such as is used in the manufacture of document boxes. This pasteboard face was six inches square. On the inside it was covered with the tungstate crystals. Where the sloping sides of the hopperlike screen met, a slit about five inches long and an inch wide was left for the eyes. Looking through this slit everything was pitch dark inside. Not a gleam of light was visible.

"Now, we'll go in here, in this other room, where we have a tube that is fairly good, but only fair, and you shall see the difference. Try the screen now," said Mr. Edison.

Instead of black darkness there was a brilliant white patch of light. It was intense, without, however, being at all blinding.

"Put your hand to the face of the screen. Do you see anything?"

What was seen was startling. There was every bone in the hand, as clear and distinct, and clean cut as if there had never been any flesh on it. At first it seemed rather horrible, this skeleton hand. But the sensation of horror soon quieted down, and there was an intense fascination in thus being able to see the bones. Between the bones of the hand were wide spaces, such as are seen in the hands of skeletons in museums. Nothing was left of the tissue.

"Now try your wrist," said the wizard.

"Don't bother about moving your coat sleeve or taking off your cuffs. They form no impediment."

The screen was shifted to the wrist over the coat and cuff and shirt and everything else. The bones stood out as distinctly as they had on the naked hand.

"What a pity," remarked the wizard, "that we haven't got a really good tube, such, for instance, as we had last night. If we had, you could see things that would certainly startle you. Imperfect as our apparatus still is, we had no trouble in seeing through thin sheets of metal, and when we get our rays strong enough, it will be no trick at all to see through four or five inches of iron."

"What I want," he said, "is this. A man comes to a surgeon with a bullet in his arm. The surgeon takes his X ray and his fluorescent screen and locates the bullet. He looks through the arm, through the bone if necessary, and sees just where it is. We've got that far already. Now, why should he want to photograph that? Simply a useless waste of time. Again, a man comes with a broken arm. A screen is fitted to the surgeon's eyes, the X ray lamp is turned on and he can work with his eyes open, so to speak, for he can see the fracture. He can see how to set the bones, can see whether they join or not, just as clearly as the cabinet-maker who glues together two pieces of wood. What would be the use of photography in that case? I am done with the photographic end of it entirely. As for the other end—well, perhaps, we may show you something before long that may be legitimately considered surprising."

ELECTROLYSIS FOR SILVER SEPARATION.

An electrolytic plant will be fitted up at the Lake Superior Smelting Works, Hancock, Mich., for the separation of the native silver which the mineral copper contains and which cannot be extracted by the ordinary process of smelting.

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St. Louis Subway Muddle.

The city of St. Louis is all stirred up again over the question of a subway system to contain all the wires that are now stretched between that city and the sun. The conditions in St. Louis are perhaps worse than was ever the case before in any city on earth. Some years ago the Municipal Assembly granted a franchise for a subway to Charles Sutter. Sanguine of sovereign right of the city to make such grant, Sutter went to work and put in several blocks of subway and spent a lot of money getting ready to put in several miles. He was finally enjoined on the ground that the city had no right to grant the franchise, and the subway was taken bodily out of the streets and hung up in the courts. In the meantime, the Laclede Gas Company claimed the right, under its original charter granted before electricity was ever dreamed of as a commercial factor, to build and operate subways for electric wires. This claim was also taken into the courts and with the Sutter case, has bred a family of troubles that have in turn multiplied and now plague the town. The Sutter case was decided by the state supreme court some weeks ago, the decision being disastrous to the franchise, the court finding that Sutter's Subway is a private concern, and that the public streets may not be used for private purposes. By implication the court held that *wire using companies* acting as public carriers are alone entitled to the use of the streets for wire carrying purposes. The Laclede Gas Company's case went to the Supreme Court of the United States by some sort of hurry up proceedings, and a decision is expected within a few days. At this writing there is a bill under discussion in the Municipal Assembly simply ordering all wire using companies now having wires overhead, to get the same into conduits before January 1st, 1900, on pain of having their poles cut down. No suggestion is made as to the method by which such a result is to be brought about, and without doubt such a bill if enacted into a law would be impossible of execution, and the companies will be protected against it by the courts.

The people of St. Louis should understand that there are some conditions to be met in the settlement of this problem beside ideal ones. This bill is intended to act as a permit without further legislation, to enable the using companies to occupy the streets. But right here another obstacle presents itself. The streets of the city average in width thirty-six feet exclusive of sidewalks, fourteen feet of which are inviolable for street car purposes, leaving twenty-two feet clear. The board of public improvements insists upon the inviolability of at least one side of the street for water, gas and sewer purposes and their insistence is recognized. This leaves eleven feet to be devoted to wire using conduits. There are now twelve companies in existence and that will have to be provided for. Each company must have at least 2½ feet for its conduit. And there you are. In the next issue of THE ELECTRICAL JOURNAL we shall attempt to help the people of St. Louis, by presenting a plan for the solution of this question, including the description of a feasible system of subways, and a financial and legal way to its installation.

* * *

Alternating Current Dosage.

We regret very much that Dr. S. H. Monell, of Brooklyn, was pleased to grow angry and personal in his discussion with some gentlemen who begged to differ with him as to the efficiency of a device which he had proposed for the measurement of dosage of the alternating current. In the current issue of the *Medical Times* and *Register*, Dr. Monell, who is responsible for the electro-therapeutic department of the paper, does the honor to devote several pages to Professor Brownell, of the Louisville Manual Training School. Dr. Monell thinks THE ELECTRICAL JOURNAL owes an apology to its readers for allowing so distinguished a physician as himself to be attacked in its columns, and altogether Dr. Monell seems to take umbrage that any one should have the audacity to question the correctness of his views. THE ELECTRICAL JOURNAL does not apologize in any sense, in

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this connection. It simply regrets that what promised to be a discussion in every way valuable to medical science, should be spoiled by Dr. Morrell's intolerance of criticism and the disposition to answer his critics by calling names rather than by refuting and disproving their assumptions. Dr. Monell was invited—nay urged, to respond to Professor Brownell's criticisms, and the columns of THE ELECTRICAL JOURNAL were placed at his disposal. He accepted by sending for publication the manuscript which is published this week in his own paper. THE ELECTRICAL JOURNAL was obliged to write Dr. Monell a most courteous letter declining the contribution on the ground that it was in no sense a reply to Professor Brownell, but was, on the contrary, an ebullition of temper that we mildly suggested, was unworthy the courteous gentleman from whom it emanated. It was suggested, also, that the discussion was too valuable a one to be lost, and Dr. Monell was urged to make a different reply, and to answer the criticism in the spirit in which it was offered. Instead of so doing, Dr. Monell goes to his own columns, where a friendly blue pencil could not follow him, and he there gives vent to some six pages of personal abuse and to a small amount, a very small amount of really interesting matter on the subject at issue, namely, the measurement of alternating current dosage.

We have not the pleasure—we may say the honor—of Dr. Monell's acquaintance, but we venture the prediction that some day the fires of youth will give way to the steadier and safer warmth of discretion, and then Dr. Monell will know that to address a gentleman as "one Brownell," is not dignified, not scientific, not augmentative, and must we say—not gentlemanly?

* * *

Central Station By-Products.

The primary and fundamental purpose of a central electric station is to furnish light and power in its immediate vicinity. Competition of gas and compressed air, and a still more active competition between the operators of rival electric plants, makes it necessary for the careful manager to resort to every means within his knowledge to save. Much well directed attention has been given to the testing of machine capacities, and the subsequent working output, in order to avoid leaks of all sorts, whether in boiler, engine, generator or circuit. But much less attention has been given to those smaller items of saving called by-products, and this subject ought to receive, and will receive, as time passes, and the necessity presses, more thorough investigation.

The manufacturer of gas for illuminating and fuel purposes provides for the expenses of manufacture by the sale of the oils of tar and ammonia, not to speak of the immense strides made by European manufacturers of gas in the production of a vast number of marvelous products which are necessary to modern industrial chemistry, such as dyes, and bases for perfumes, and for synthetic chemistry generally.

The competition of gas companies in the electrical field is seriously felt and the gradual development of the gas engine will, undoubtedly, further complicate the question.

Little economies, such as the saving of spent and used up oils, either for future use or for sale; the sale of worn out incandescent lamps, the platinum wires of which can be used, as well as the sockets; the sale of the carbon ends from arc lights; all these are trifling matters, but these trifles eventually amount to considerable.

One central station in this country makes the sale of its exhaust steam for heating purposes an item of importance, in fact, it has been asserted that in the winter season this item of the receipts in more that that named from the sale of current.

It is only necessary to call attention to the fact that the supremacy of Chicago in one line alone, that of meat packing, is due to just that careful utilization of products, which, a few years ago, were thought to be mere worthless offal,

* * *

Underground Trolley Taking Shape.

The recently launched proposition to build an underground trolley road in Chicago, with elevated terminals in the suburbs, seems to be taking definite form. It will probably be demonstrated before long that the project is a tactical play on the part of one or the other of the warring factions on the south side of the city. But that fact is rather in favor of the execution of the work in the event that the council can be induced to forego for once the one ruling law of its existence—boodle, and enact the necessary legislation. It has not been denied for a long time now that the underground trolley is practicable and commercial. Nor do we think there would be very violent opposition to it if it were not for the fact that most of the electric roads have been so recently changed that their overhead equipment has not yet been earned. In such a case we understand how a company would protect against another and still greater expenditure. However there are many roads that are veritable gold mines and could be made, without hardship, to put in underground equipment in place of overhead. Especially is this true of those roads running into the downtown district of Chicago. The only one that is not earning money is the McGann road and that has not only no down town terminus, but has really no logical suburban starting points. That road will hardly be allowed to build an overhead line down town, and its managers will undoubtedly be willing to put in the Love or any other feasible system rather than be shut out. We believe the real repugnance of the roads to the underground equipment for down town districts is due to the apprehension that if they allow that equipment to be successful, they will be compelled, by public opinion, to put it in all over the roads. If this fear were eliminated we believe that even the Yerkes management would not long protest against the change. They all recognize that it would be a great advantage to have the wires removed as a source of danger, and put out of the way of harm.

* * *

Instruction By Correspondence.

In another part of this issue will be found the advertisement of the Correspondence School of Technology, of Cleveland. As the National School of Electricity stands for the education of the people and especially those seeking an opportunity to better their business condition, so THE ELECTRICAL JOURNAL is anxious to bring to the notice of its readers every method by which they may acquire the fullest possible knowledge of the interesting and fast growing science of electricity. We have been in position to learn during the past two years that the Correspondence School of Technology is doing an admirable work. No one will pretend that education by mail will take the place of either individual, personal or class work, but there are thousands of young men and women, manufacturers, mechanics, engineers and artisans all over this country who are not so situated that they can avail themselves of school training, and where they must either do without the knowledge or acquire it by study at their own homes. There is no question that the courses of study prepared by the Cleveland School are admirably adapted for the purpose. These courses have one advantage over class work that must be admitted, and that is that students who are very slow to learn can have all the time necessary at their disposal, and will not be hurried along by a class more rapidly than they can profitably go. The National School of Electricity receives many inquiries concerning a correspondence course, mostly from those who would, if possible, join its classes in the various cities. The School management has admitted and does admit its inability to give such instruction in a comprehensive and profitable way, and it has therefore declined to make a feature of correspondence work. Its management has taken the pains to investigate the operations of the Cleveland School and does not hesitate to say that its work is systematic, painstaking, comprehensive, and in every way well directed.

"Our genial fellow townsman" as our rural contemporaries would say, Frank B. Rae, has been employed as engineer to estimate the cost and prepare plans for a proposed municipal lighting plant at Madison, Wisconsin, to cost approximately $25,000. Hoo Rae!

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General Electric-Westinghouse Agreement.

We are not in sympathy with our cataleptic contemporary which continues to have conniption fits over the business arrangement recently entered into between the General Electric and Westinghouse Companies. We do not contend that consolidations of large interests are for the best good of an industry--other things being equal. But in the electrical business, as it stands today, other things are not equal. For instance, a very large proportion of the ills that afflict the electrical business are due to the looseness, or worse, of the methods of the patent office, and consequent litigation. This blight has afflicted, not only those directly interested in special cases, but has had the effect of frightening away capital, and of making that already tied up in electricity much more timid than it would otherwise be. So that we regard any sort of arrangement that will take electrical interest out of the courts as extremely to be desired and encouraged. We have had, for some years, entirely too much litigation. Conditions in several directions are promising just now, and furnish food for the prediction that much good work in the direction of practical advancement will be done in the near future. We all know to what an unsatisfactory condition the storage battery business had come. Whether the interests of individual concerns will be best protected by the combination recently entered into or not, remains to be seen, but it is an indisputable fact that the storage battery as a commercial factor has made more advancement within six months than in years before. We all know to what a miserable condition the industry of electric heating had come, entirely due to litigation. Within the month a combination has been effected that promises much for the future of electricity especially in domestic heating. And so instances might be multiplied *ad infinitum*, to show that good rather than harm comes from combinations that have for their object the avoidance of litigation or the proper direction of capital.

* * *

We Are Out of the Dark Ages.

For a good many years, and until very recently, it was considered in very bad taste for a scientific man to air his views in the popular press. The two professions of medicine and electricity seem to have been more the slaves of this kind of narrow mindedness than the other professions, those of law and theology having been comparatively exempt. For a decade past, the younger men in the medical profession have been shaking the shackles of the "code," and now we find Edison and Tesla absolutely disrupting the old order of things by telling the newspapers what they are doing in their respective fields of work. This is as it should be. From time immemorial it has been the custom of learned men to maintain their ascendency over the masses of the people by enveloping their craft in a veil of mystery. The Nineteenth century has a good many marvellous advances to its credit, but foremost of these is the uprooting of the tendency to keep the people in ignorance. By the way, if a close observer will listen to a conversation between two or three people on the subject of some recent discovery heralded in the newspapers, he will hear at least one of them question the merit of the fact of the discovery, simply because it appeared in a daily paper. Whereas the same man would accord full credit to some story if it appeared in one of the magazines. Our experience is that this belief is wholly wrong--for the simple reason that most magazine articles are prepared by interested people and are many times warped for selfish purposes. While on the contrary, newspaper stories are gathered by reporters interested only in the matter as news, edited and re-edited, and often refused by responsible papers if unworthy, or at least discounted in the headlines or introduction. We are firm believers in the principle of letting the people into all that is going on in every branch of science, art and industry, and there is no way so likely to do as much good as the medium of the daily press.

The subscription price to THE ELECTRICAL JOURNAL is $2.

Germicidal Effects of High Frequency Currents.

We shall hope, in our next issue, to give at some length, the results of the work of Professors d'Arsonval and Charrin, as described at some length by them a few days ago to the French Academie, on the subject of the effects of high frequency currents on bacterial toxines and by-products.

In another column will be found a note on this subject, the most important statement of which is, that both the investigators have concluded that these high frequency currents are capable of so weakening the bacterial poisons that they may be used to render persons immune, by inoculation. While much work has been done in the microscopic field of bacteria culture and inoculation, it goes without saying that any announcement from so thoroughly reliable a source as this we quote, will be received with enthusiasm. The germ theory of disease has come to be pretty nearly conceded, and the next substantial advance, after having determined the existence, location and character of a germ, will be to hunt him out of his lair and make way with him. If electricity can be made to aid in this consummation, it will be another leaf in her laurel crown.

* * *

The Lenox Avenue Line.

The dreaded winter that was to prove the utter discomfiture of the underground trolley road, has come and gone and the Lenox Avenue Line of New York City has the record of not having missed a trip on account of storms, snow, ice or water. The storm of March 10th and 11th gave the system the severest test of the winter. The snow plow sent out early on the morning of the 11th broke down and was laid up for the balance of the day. Notwithstanding, the electric cars made regular trips, only being delayed a few moments due to slipping of the wheels on the rails, and the consequent necessity to run more carefully for safety. In some cases, the cars had to be backed up to gather enough momentum to drive them through the heavy drifts. If further proof of the success of the experiments were required it might be found in the fact that the management of the Metropolitan Traction Company, of which the Lenox Avenue Line is a part has ordered a great quantity of additional equipment.

* * *

Subsidizing Electric Roads.

There is a bill before the British parliament providing for government aid toward the building of "light freight" railways into the rural districts of England for the benefit of the agriculturists. Incidentally, the electrical manufacturers hope to profit by such legislation to the extent of equipping the proposed roads. There is hardly a doubt that the roads, if built, will be electrical, and there is certainly no doubt that the roads would help the farmers, to some extent, but the facts in this case point out most clearly the differences in the conditions between this country and other parts of the world—even England. Who would think of granting subsidies to electric railroads in this country? Or how long would it take private capital to get into operation where the conditions were so urgent as to call for legislative enactment?

* * *

Brother Hamill Takes a Hand.

An exchange prints the following: "The Brush Electric Company, Cleveland, says: 'We favor the application of reciprocity to future legislation. We believe it the most excellent business idea. The effect of the reciprocity treaties in 1890 was most favorable, and their repeal most unfavorable to the electrical business. Incidentally we beg to state that we are for McKinley as the next President. Our company is composed of Democrats and Republicans, but we feel that if McKinley is elected we will know positively that the tariff on electrical apparatus will not be tampered with.'"

If there is anything worthy of vociferous applause it is the way our friend Hamill sheds his coat and steps into the ring.

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The Bluff Was Promptly Called.

The Borough Council of Holidaysborough, Pa., declined to make any contract with the Electric Light Company for city lighting, but has passed an ordinance appropriating $15,000 for a Municipal Plant. There were recently two lighting plants in operation in that town, but one burned down just before the contract for city lighting was to have been let. The burned-out company had asked a very reasonable price for its public service, and would have been awarded the contract. The other company took advantage of the accident to ask an exorbitant price for its services and in addition wanted a three year contract.

* * *

The Roentgen Ray Craze.

We have been waiting very patiently for some one in this country, to do something in connection with Roentgen rays; that was not done months ago by Prof. Roentgen, himself. Up to the present time, we are able only to point to Mr. Edison's work as likely to be an advance in this direction. There has been a wild scramble on the part of a lot of people who would never be heard of in science, to get before the public. The subject, being an interesting one, the daily papers were ready to print most anything. Hence a big lot of rot, and a good deal of disgust on the part of the public, and the real scientists.

* * *

A Human X Ray.

The *Terre Haute Express* makes the statement that Robert Dwight Harrison, a graduate of Miama University, class of '81, was the real discoverer of the so-called ray photography. In experimenting with Rhumkorff coils and Crooke's tubes, an accident almost deprived him of sight. When he recovered he found that the optic nerves of both eyes had been "Roentgenized" and he saw his relatives, friends and all others only as skeletons. It is only fair to say that Mr. Harrison is an inmate of an insane asylum near Cincinnati. What a magnificent government metal inspector he would make! But perhaps Mr. Harrison's wish concerning his relatives was father to the peculiar sight.

* * *

Dr. Roentgen was called to the Imperial Court of Berlin and took an X ray photograph of the crippled left arm of his august Majesty, Wilhelm II. His Imperial Majesty's surgeon now declares that he can rectify Willhelm's infirmity and make the lame arm as good as new. We are loth to believe, however, that his aged grandmother, Queen Victoria, has been trying to get an X ray photograph of Wilhelm's tongue and brain with a view of having surgeons try to get them in accord with her views.

* * *

The acute observer will notice the advertisement in the daily papers of the Welsbach lamp. A year ago the company claimed that it was five months behind its orders. The signs of the times point to the fact that they have caught up. In other words the prediction made months ago by THE ELECTRICAL JOURNAL that the Welsbach lamp would be buried in its own "shroud" is in fair way of fulfillment. Requiescat in Pace!

* * *

The next sensational news in railway circles will be that Charles T. Yerkes and his associates have bought a controlling interest in the Metropolitan Elevated Electric Road of Chicago. Mr. Yerkes' smile is assuming that direction.

* * *

Sandow has submitted to the X rays to locate some glass he had got into his foot. Next to being in "the public eye" commend us to the art of getting under the X Rays, thence into the newspapers.

* * *

Either the acetylene gas business is one of the biggest humbugs of the age or its promoters have a gold mine in the shape of damage claims against the *Engineering and Mining Journal*.

A club-man who came home one night very recently at the unseemly hour of 8 a. m., and in a condition that manifestly admitted of no explanation, found that his wife had superimposed the family cat upon a sensitive plate and by rubbing the fur of the animal the wrong way had succeeded in getting an X ray photograph of a $300 seal skin sacque. The bill will be photographed later.

* * *

The municipal authorities of the village of El-Biar, Algiers, which has a total population of 800 souls, has signed a contract for an electric plant which will light the two streets which traverse the town. Private lighting will be furnished also, the principal customer being the convent of the Good Shepherd, which has extensive buildings there. How about "Darkest Africa" now.

* * *

Some Calcutta, India, sportsmen recently used the incandescent light for hunting tigers in the jungle. Five candle power lamps were suddenly turned on and before the tiger became accustomed to the light the sportsman had got in his deadly work. In this country the "tiger" uses the bright light to hunt men

* * *

Science has again gone up against the Bible with such force that at least one divine, the Rev. Frank Crane, of Chicago, has deemed it necessary to preach a sermon on the Roentgen rays, taking for his text the following verse:

"The Lord seeth, not as man seeth, for the Lord looketh upon the heart, but man looketh upon the outward appearance."

* * *

The *Boston Herald* publishes a column of leaded editorial on an invention by "a well known inventor" by which electricity is produced directly from coal without going through the process of steam. No details are given, the balance of the column being employed in a word picture of the advantages of the discovery. This information is of vital importance—if true.

* * *

Dr. Harry G. Pratt, of Chicago, has "discounted" Edison's work with the Roentgen rays, according to *The Times-Herald*. Let us try to keep the news from Mr. Edison. We do not want him to get discouraged and quit—at least before the light of genius shall have shed its effulgent rays on—Dr. Pratt for instance.

* * *

Apropos of the electrocution bill now before the Ohio legislature, we do not believe that the example of New York will ever be followed in any other state. Let the rope suffice until capital punishment is done away with!

* * *

If this thing keeps on all a doctor will have to do will be to hold a patient up to the Roentgen ray to see what ails him, then deposit the requisite amount of the proper medicine exactly on the spot by means of cataphoresis.

* * *

As an evidence of the fascinating effects of the late lamented "Midway" on our esteemed contemporary, the *Western Electrician*, the "streets in Cairo" is represented in its last issue. "La, la! la, la, la!"

* * *

An electric substitute for the "bell cord" in trains, is being tried on the London Southwestern railway. It is simply a system of push-button signals

* * *

Electricity, (London), instructs its readers as to the difference between a telephone staff and a telephone pole.

* * *

If this thing keeps on, the least stain on the conscience will be subject to inquiry by the X Ray.

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JUNGFRAU ELECTRIC RAILWAY.

International Competition With Six Thousand Dollars in Prizes to Settle Some Engineering Questions.

The commission of the Jungfrau Railway has opened a competition, international in character, for the solution of a number of questions connected with the construction and operation of an electric railway proposed to be built to the top of the famous peak. Prizes amounting in all to $6,0 0, are offered to the successful competitors. Points to which attention is directed, are as follows:

THE DESIGN OF THE LINE.

(*a*) The section of the tunnel, without, and with stone lining; the foundation and overhead construction, rails, rack-rails, switches and crossings.

(*b*) The system to be adopted for the electric transmission of the power; equipment of the primary stations; system of distribution of the current along the line; protection against atmospheric disturbances.

(*c*) The electric cars, with all the necessary safety devices.

(*d*) Designs for the station building and restaurant at Eigergletscher Station.

(*e*) Construction and equipment of the intermediate stations.

(*f*) Design of a *Klubhutte* shelter to take fifty persons at Monchjoch Station.

(*g*) Elevator, about 100 meters high and 8 meters in diameter, provided with staircase, at the summit of the Jungfrau.

THE CONSTRUCTION OF THE LINE.

(*a*) The boring of the tunnel; electric boring machines, blasting material, ventilation.

(*b*) The removal of the spoil.

(*c*) Precautionary measures for the maintenance of health and life of the workmen, patterns of movable barracks.

THE WORKING OF THE LINE.

(*a*) Plans for the insuring under the given conditions a continuous working of the line.

(*b*) Electric lighting of the tunnel, cars and stations.

(*c*) Electric heating of the cars and stations, precautions for the safety of passengers and working staff.

One or more of the above points may be dealt with by a competitor or several competitors collectively. Further suggestions likely to be of advantage to the Jungfrau Railway undertaking are also invited.

The scientific commission, with the assistance of experts will settle the award of the prizes. The results will be published. Upon the prizes being distributed the Jungfrau Railway Company will acquire the right to use the plans obtaining prizes without further compensation. The commercial copyright will, however, remain the property of the author. Rejected papers will be returned.

The following data are given:—The maximum gradient of the line is 25 per cent. The guage is one meter. The sharpest curve is of 100 metres radius, and the maximum radius is 500 metres. The greatest width of car must be 2.5 metres, the greatest height three metres, the maximum speed seven to ten kilometres per hour. The water power at the disposal of the electrical plant is about 5,000 h. p., and will be taken from the river Lutschinen. The distance between the power house and the starting point of the line on the Kleine Scheidegg is about eight kilometres, from there to the tunnel entrance it is two and a half kilometres, and the tunnel has a length of about ten kilometres.

Competitors must illustrate their schemes by drawings or models, and must also enclose estimates of cost. The latest date for sending in schemes is August 1, 1896.

Further information may be obtained from *Bureau der Jungfraubahn, Bahnhofstrasse* 10 *Zurich, Switzerland*, where also general plans, the result of geological investigations and details of the water power available, may be obtained.

The Scientific commission of the Jungfrau Railway will consist of Prof. Becker (Zurich), H. Brack, technical director of the North East Railway (Zurich), Prof. Golliez (Lausanne), Dr. Maurer, (Zurich), Dr. L. von Salis-Guyer (Basle), Dr. Schmid (Berne), Rev. G. Strasser (Grindelwald), E. Strub, railway engineer (Interlaken), Prof. Walder-Meyer (Zurich), Prof. Weber, (Zurich), Dr. Wrubel (Zurich), and President Guyer-Zeller.

A NEW FORM OF GENERATOR FOR LABORATORIES.

C. H. Thordarson has designed, for the use of physical laboratories, a novel form of small dynamo which seems to fill a long felt need. It combines in one piece of apparatus a direct current dynamo, which can be used as a series or shunt wound machine; or it may also be used as a single phase alternator, as a two phase alternator, or a three phase generator by a simple arrangement of binding post connections and commutators and thus serves to illustrate the construction of all these various types of generators.

It can also be used as a series or shunt wound direct current motor, or as a motor-transformer, and as such will give single, two and three phase currents.

While the electric current can be shown in these interesting ways, the magnetic circuit has also its points of interest; and this machine is designed to exhibit these lines of magnetic force in a way never before accomplished on an operating machine. The portion of a magnetic field which lies in the air space between the armature and the field magnet poles takes on a very peculiar shape according to the work the machine is doing. This can be well shown by iron filings distributed over a glass plate and laid over the poles. When the machine is running separately excited, the lines of force form straight lines from pole to armature; but as soon as the current is taken from the armature brushes the lines of force are shifted forward. This shifting, which is due to the magnetic reaction of the induced armature current, will naturally increase with an increased armature current. This magnetic lead can be shown to change by rocking the brushes into different positions on the commutator. All this can best be shown by means of iron filings. Reversing the field current by means of the field switch, the filings can be shown to rapidly reverse and rearrange themselves in diametrically opposite position.

IN THE NEAR FUTURE.

FIRST DOCTOR.—Good photograph, isn't it?

SECOND DOCTOR.—Fairly good. Flatters the left lung a little, I think.—*Puck.*

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GOOD SHOWING FOR CENTRAL UNION.

The report of 1895 recently made by the Central Union Telegraph Company, outlines more clearly than any other statement could, the actual conditions affecting the telephone business. The company owes the American Bell Company $800,000, and needs $800,000 more to improve its service. Hence it will issue $1,6 0,000 in bonds, most of which will be taken by the insiders. This last fact shows that the large shareholders do not anticipate a collapse of Bell companies due to mushroom competition. The report showed that the number of instruments in service increased 20 per cent. and that the gross income decreased $78,837.00, but that with this showing the usual 5 per cent. dividend was paid and a small surplus was left over. This last statement shows that the patrons of the company are getting the benefit of lower rates due to improved methods and the expiration of some of the patents, on which it is not longer necessary to pay royalties. It also shows that the telephone business has grown steadily and as the increase in the number of instruments in service is greater than usual, it shows, that the so-called independent companies are not materially affecting the profits of the Bell interests.

THE CATHODE RAY.

There's another new invention
Which these scientific crimps
Discovered, just to help along
Old Satan and his imps;
It is worse than all the others
They have brought out in our day,
And the name of this new demon
Is

the

cathode

ray.

With this new-fangled lightning
They can look a man right through,
And can see what he is thinking,
Tell you what he wants to do,
Count the money in his pocket:
Then with laughter they will bray
When they only find a nickel
With

their

cathode

ray.

Just suppose you have a dollar
And you start out for a feed;
But you meet that bill collector
Who is wont with you to plead,
You have stood him off so often
That you think 'twill be but play,
But the fellow finds that dollar
With

his

cathode

ray.

From the streets the gossips watch you
When your house is in a whirl,
And your wife through three partitions
Sees you kiss the hired girl,
She in anger chides you for it,
Then you get a gun and pray
For a shot at the inventor
Of

that

cathode

ray.

—*Chicago Record.*

JAMES WOLFF.

The subject of this sketch needs no introduction to the electrical public, East or West. That smile is copyright, prepared by a secret process—none other genuine.

Mr. Wolff admits having been born in New York City, the interesting event dating back to November 27, 1861, and was the signal for hostilities between the North and South. Ushered into life amid booming cannon, Mr. Wolff became early imbued with a desire for the fray and immediately upon arriving at a fighting weight, girded himself about and went into—Wall Street. For eight years prior to 1892, Mr. Wolff was general manager of the Independent District Telegraph Company, until it was absorbed by the Western Union. Since then he has represented the New York Insulated Wire Company—the past two years in Chicago. Gothamites would probably call him a traitor and renegade, for he has entirely broken the fetters of domestication as viewed by the average Manhattaner, and is an integral part of the wild and woolly West. Not only that; but he glories in the low and vulgar society of the nation's abattoir, and seems to live along fairly well contented—barring a certain loneliness that perhaps time and some sweet girl can go a long way toward eliminating. That's about the only thing the Westerners have against "Jim" Wolff. They don't take it as a compliment that he holds coldly aloof, when there are so many girls that they think charming, who would be willing to make things comfortably warm for him. However, they do say there is a doctor working on his complaint and may be she will work a cure. Jim Wolff is one of the men people are always glad to see. He has always a cheerful pitch to his voice, even if he has just lost a wire contract, and if it so happens that he has occasion to call on one about "that little bill," there is usually some how or other a mitigating circumstance—such as the discovery that the bill isn't as big as one had thought—or something of that sort.

SEARCHLIGHTS AS RIOT QUELLERS.

The electric searchlight was used recently to put down a riot in Lancashire, England. A manufacturer, whose men had struck, was determined to keep his mill going, and he promptly secured new hands and set them to work. At the same time he fixed a searchlight on the factory building to prevent the strikers from setting fire to the sheds erected for the new hands. During the continuance of the strike this light was used nightly, in conjunction with the police established in the works, to scour the country and to illuminate the parts where pickets were placed. It was found so effective that a large number of temporary police were dispensed with.

A few days ago an iron bridge at Allegan was the scene of a number of amusing antics by the people and animals that crossed it. An electric light wire had come in contact with the metal on the bridge, electrifying the whole structure, and it was some time before the cause of the strange capers cut by travelers crossing it was discovered and remedied.

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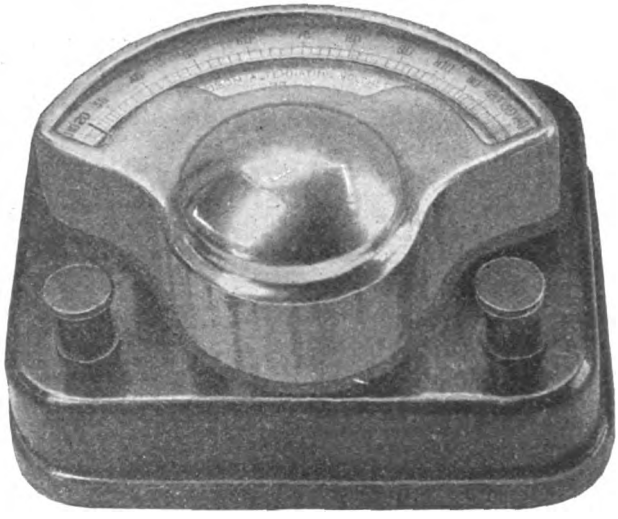
ALTERNATING CURRENT INSTRUMENTS.

General Electric Company's New Volt Meters and Watt Meters Low in Price and Accurate in Performance.

In the matter of portable instruments for alternating current work, the practical electrician has, heretofore, been compelled to choose between the high-grade high-priced instrument and the low priced and usually unreliable one. Reliable portable instruments at reasonable prices have been lacking, and as a consequence the demand for them has become both crying and extensive. Realizing this fact the General Electric Company has undertaken to meet this demand by placing upon the market a complete line of ammeters, voltmeters and indicating wattmeters and giving to the electrician, for the first time a line of portable instruments in which full reliance may be placed as standards at a comparatively low figure.

These devices developed by Professor Elihu Thompson, embody all the improvements which knowledge of every requirement and long experience suggest. They are compact in form and accurate, and may be used on all alternating current circuits whatever the frequency and whatever the wave form. No parts liable to change enter into their construction: their calibration and accuracy consequently are insured for an indefinite period. These instruments are of the series type.



THOMSON ALTERNATING CURRENT VOLTMETER.

The difficulties inherent in shunt instruments are thus happily absent. They are dead beat, a depressible button operating an attachment by which the needle is immediately brought to rest without detracting from the sensitiveness of the instrument.

The ammeters are standard for alternating current work, but may be used with good results on direct current circuits, in cases where the highest accuracy is not required. The indicating wattmeters, give accurate readings with angles of lag on all inductive loads met with in commercial practice. A special field will be found for these in central station practice, testing and calibrating recording meters, testing transformers and measuring their efficiency, in testing the energy consumed in alternating current arc lamps and incandescent lamps, small fan and other motors, etc.

With the indicating wattmeter accurate measurements on direct current circuits may also be obtained provided two observations for each reading are taken with the instrument connections reversed between the readings—the mean of the two readings giving the correct result. Upon each wattmeter the maximum current at which it may be used is marked. They indicate accurately on any potential from 0 to 150 volts.

The range of sizes of these instruments is such as to meet all and any requirements. The ammeter is made in the following capacities: 2-10-25-50-100 and 200 amperes; the voltmeter for 75 and 150 volts; and the indicating wattmeter for 100, 300, 1500 and 2500 watts, that for 100 watts having been especially designed for measuring iron losses in transformers and for testing incandescent lamps. The scales are exceptionally long and clear.

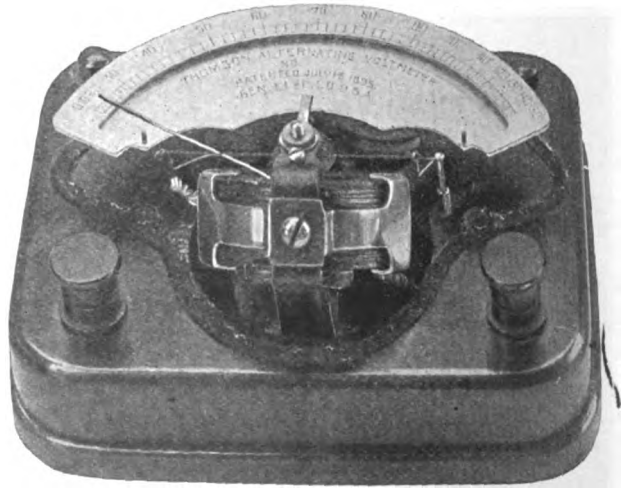
THOMSON INDICATING WATTMETER.

In appearance and workmanship the instruments may be favorably compared with the most costly on the market. They are both neat and handsome, having bases of mahogany and covers of polished nickel. Each instrument is packed in a hardwood carrying case.

These instruments are known as the Thompson Inclined Coil Portable Alternating Current Instruments, and the principles of construction can be gathered from the illustration.

A BIG CABLE AIR LINE.

According to the Detroit *Journal*, Cincinnati is preparing to engage in the erection of an engineering and mechanical novelty. Immense cables are to be strung across the Ohio



THOMSON ALTERNATING CURRENT VOLTMETER—COVER REMOVED

river, connecting Cincinnati with Ludlow, Ky., upon which a transport car will be hung and moved back and forth by means of overhead pulleys. While a similar device has long been in use for carrying dirt, stone and material on the Chicago canal, it has never been used in passenger traffic. Two steel towers, each 152 feet high and fifty feet square at the base, are to be erected, one on each side of the river, 1,760 feet distant from each other. The towers are to be connected with four patent

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steel carrying cables of fifty tons tensile strength. Between each tower there is to be a waiting room, and at the side of each tower will be the landing, to which the car descends.

The hoisting and propelling machinery, weighing sixty tons, will be located in the towers, sixty feet above the ground. The span of the cables will extend 1,760 feet, being 150 feet from the ground at the ends, and having a sag at the center of from sixty to ninety feet, according to the load suspended to them. The car will weigh ten tons, empty, and will carry fifty people. When the car is loaded it will be hoisted vertically from the landing until, by a series of automatic clutches, it is suspended to the pulleys on the four carrying cables. It will then be propelled by a system of tug cables and pulleys across to the opposite tower, travelling at the rate of 1,200 feet a minute. At the opposite end it will be lowered to a landing, and the passengers will disembark.

Some idea of the immensity of the undertaking may be gained when it is known that the towers will be higher than any building in Cincinnati, and that the whole plan involves an outlay of over $100,000. It will require two miles of two-inch cable and eight miles of running cable.

HIGH TRAGEDY IN WASHINGTON.

They do things very serenely, but very effectively in Uncle Sam's tennis court. At Washington, a few days ago, the president, superintendent and three linemen of an electric lighting company, involved in the erection of a pole which had been forbidden by the authorities, were arrested and locked up. Two workers were caught at the top of the pole and kept there for several hours. It was a really funny incident. President Thomas landed a gang of men at the scene at daylight, and began stringing wires to the pole that had been erected at midnight. Two men were ordered up to do the stringing. The police drove up in a "hurry buggy," about the time the men got to the top of the pole. All the men on the ground, including the president, were given reserved seats in the chariot of the law and the men in the air were ordered down to keep them company. Then the old story of Casabianca was rehearsed. President Thomas told them to go on with their work, and not to come down until he told them to. Then President Thomas was given a ride. True, to their orders the men began working. The hours ensuing, were enlivened by a running oratorical soliloquy on the part of the policeman left to arrest the men. At noon one of their number climbed to the roof of an adjoining house and lowered lunch to his associates. As no one lowered lunch to the policeman or relieved him, he tried to force the issue, but only succeeded in playing low comedy to the street gamins. It was high tragedy to the men on the pole before they finally received orders to follow the kindly advice once given to an animal similarly situated by the late lamented Mr. Crocket

AN X RAY PORTRAIT OF A LADY.

She is so tall, so slender; and her bones—
Those frail phosphates, those carbonates of lime—
Are well produced by cathode rays sublime,
By oscillations, amperes, and by ohms,
Her dorsal vertebræ, are not concealed
By epidermis, but are well revealed.

Around her ribs, those beauteous twenty four,
Her flesh a halo makes, misty in line,
Her noseless, eyeless face looks into mine,
And I but whisper, "Sweetheart, Je t' adore,
Her white and gleaming teeth at me do laugh.
Ah, lovely, cruel, sweet cathodograph!

—LAWRENCE K. RUSSELL, *In Louisville Times.*

MOTOR VEHICLE FOR THE QUEEN.

A Glasgow paper says that an electric chaise was ordered by the late Prince Henry of Battenberg for the Queen of England. The body of the carriage will be composed of aluminium, and it runs upon three wheels, fitted with michelin tires; the car is propelled by means of accumulators.

LAG IN THE ALTERNATING ARC.

Discussing a paper read by Professor Fleming on "An Analytical Study of the Alternating Current Arc" before the London Physical Society lately, Prof. S. P. Thompson gave the results of some interesting experiments. He said that when the fact of the existence of the difference in phase between the current and volts in an alternating arc was first published, he had made some experiments which showed that there was a lag and not a lead—*i. e.*, that the arc acted as if it possessed self-induction. The resistance also lagged, and he thought this lag might be due to a thermal lag. The temperature of the arc will lag behind the current both when it is increasing and when it is decreasing, and if the resistance of the arc depends on the temperature of the vapour in the arc then the resistance would also lag behind the current. It was not possible from *a priori* reasoning to say whether or no an alternating-current arc could ever be obtained of any efficiency equal to that of the direct-current arc. With suitable carbons, length of arc, current and volts it seemed to him that it might be possible to obtain an equal efficiency. The light-giving process in an arc is not merely an irreversible degradation of electric energy into heat, for the difference of potential between the carbons may be written $V = a + b\,l$ where a may be regarded as a back electromotive force and $b\,l$ as a true resistance. The first term of this expression does not vary with the length of the arc, l, but the second term does. Multiplying through by the current, C, the equation watts expended $= C\,a + C\,b\,l$ is obtained. It is the first of the terms on the right-hand side which is a reversible effect, and corresponding to the power expended in driving the current against a back electromotive force, on which the light given out chiefly depends due to something occurring at the crater surface.

TWO ELECTRIC NOVELTIES.

Two novel applications of the portable incandescent light, supplied from a storage battery, have recently appeared in the streets. One is the use of the electric lights in carriage lamps. Many private carriages have now the electric lamps, and they are a great improvement, both in usefulness and attractiveness, over the flickering candles. Usually a small bulb, an inch and a half long, of two to four candle power, is used. One carriage that has been seen on most opera nights lately waiting outside the Metropolitan Opera House, says the New York *Sun*, has a cluster of three small bulbs in each lamp, and the glass of the lamps is cut heavily in patterns that refract the rays in a brilliant manner. The light is strong enough to be striking without being spectacular, and the turnout has a decidedly smart appearance.

The other use of the portable light is the latest wrinkle in advertising novelties. A tall man, wearing a high hat, strolls leisurely along upper Broadway, where the crowds are thickest, every night. There is nothing remarkable in his appearance. Suddenly his silk hat seems to burst into flames, and on the back and front appear, in glowing letters of red, white and blue lights, three lines of words advertising a new article for sale in this city. The words flame forth in startling distinctness for a few seconds, and then disappear as suddenly as they appeared. The man saunters along all the time apparently entirely unconscious of the phenomenon in his hat. The novel advertisement attracts the attention of all the pedestrians in sight of it, and they turn around to watch the flaming letters as these burst out and fade away every half minute or so. There is an incandescent electric light bulb in the man's hat, supplied from a storage battery carried in his coat pocket, and a button in the palm of his glove switches the light on and off. The transparent letters cut in his hat do not show when the light is turned off.

In Paris, there are at present, nine large manufactories, in full work, turning out horseless vehicles.

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ELECTRICITY ON THE WESTERN COAST.

Water Power from Many Hills—To Furnish Current for All Sorts of Purposes—Santa Rosa in the Lead.

In order to utilize the vast power of the Kern river, which flows from the perpetual snows of Mt. Whitney, the Power Development company has gone to a point twelve miles distant from Bakersfield, where it has carried a large part of the river along the bluffs to a point where the river suddenly drops, so as to give a fall of 200 feet over the bluffs. To carry this enterprise to completion the company has used 8,500 feet of flume and 600 feet of pipe line, the pipe being sixty-six inches in diameter and the largest ever installed in California.

It would be difficult to estimate the untold advantages which are yet to flow from the fact that these falls develop 8,000 horse-power. It will be some time before that vast force can be utilized, but the company has arranged to install 1,200 horse-power at the outset, and contracts have already been made by which one-third of it will be utilized by the town and surrounding country as soon as the plant is ready for operation.

Among the immediate benefits will be the lighting of Bakersfield by electricity and the operation of a projected street railroad by the same force. This great work is being prosecuted with unabated vigor, and forty teams and 100 men are constantly employed to push it to completion. It is believed that in about six months the plant will be complete so as to furnish power in Bakersfield. To complete this work with the quadruple circuits will require eighty miles of copper wire, which weighs 60,000 pounds. The paid-up capital of the company is $500,000, and there are no bonds—or debts of any character. It will require $200.000 of this amount to complete the road. One of the first effects which will follow the completion of the circuit will be the building of the street railroad lines to connect the Southern Pacific depot at Sumner with the Valley Railroad depot in the southwestern part of the town. This will be followed by various cross and connecting lines, which will add to the convenience of the people.

ELECTRIC LIGHTS ON BATTLE FIELDS.

Special attention is being given by the French military authorities to the question of succoring the wounded on battle-fields when night comes on after a great battle. Experiments have been made with powerful electric arc lights, but the apparatus has been pronounced cumbrous and practically unavailable under the contemplated conditions. At length it has been practically determined that the ambulance corpsmen shall wear little incandescent glow-lamps on their hats, just like the ladies of the ballet in a spectacular extavaganza. Each man is to carry a little primary battery in his pocket for the production of the current. The wounded in need of succor will look out for the little moving lights and if possible drag themselves toward them.

ELECTRIC CARS ON BROOKLYN BRIDGE.

The Brooklyn Bridge Trustees, at their meeting in Brooklyn, March 23rd, took an important step toward abolishing the use of the cable and locomotives on the structure. Chief Engineer Martin reported that the experiment with an electric motor car for switching trains, as well as hauling them over the big span, had proved an entire success.

On his recommendation it was decided to purchase twenty cars, with electric equipment, at $3,650 each, or $73,000 in all.

Mr. Martin estimated the cost of an electric power house at $30 ,000. He was ordered to prepare plans, and a contract for the construction of the new building will probably be awarded within a few weeks.

Portland, Michigan, last week voted in favor of bonding the village for $15,000 for a municipal electric lighting plant.

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FRUIT DRYING BY ELECTRICITY.

The drying of fruit by electricity, is suggested as an industry worthy of inquiry at least, in the opinion of *The Electrician* (London). It is well known that fresh-gathered fruit must be dried before being packed. This process, although an apparently simple one, necessitates great care, and the temperature must be well regulated, otherwise there is danger of the fruit being damaged. Large drying rooms are in use in some cases, heated by means of steam, and although this system may be cheap to work on a large scale, it is not always so satisfactory on a small one. Fuel, moreover, is often expensive, and water power, in parts where the fruit trade flourishes, is usually abundant. In such situations electric heating could be used with advantage. The perfect regulation allows of any temperature being obtained, and, what is of great consequence in such an installation, practically no attention would be required. The electrical plant, too, could be used for lighting, and a few motors to aid the packing could easily be laid down. Uses, such as this, offer a fine field for development, and the gain made, by bringing in cargoes of sound fruit would far more than cover the cost of running the necessary machinery. The above remarks have special reference to the storing, packing and shipment of fruit to the English market; but the same treatment as to drying might well be adopted in connection with our English fruit gardens, and it is quite possible that some such process might materially assist in making our orchards more profitable, and lead to extensions so much to be desired.

NIAGARA FALLS LIGHTED BY ELECTRICITY.

Niagara Falls is now being lighted by power furnished from the big power house of the Niagara Falls Power Company.

The steam plant of the Niagara Falls Electric Light and Power Company which has been used to develop electrical power to light the city succumbed to the energy of the Niagara for the first time on March 22nd. The fires were shut down, the wheels of the engine stopped moving, steam ceased to generate.

The Niagara Falls Electric Light & Power Company decided some time ago to abandon its steam plant and equip its works with up-to-date electrical machinery. Two 300 horse-power induction motors of the latest improved Westinghouse pattern were ordered. They were delivered several weeks ago, and the work of installing them was completed only a day or two ago. They were tested a few days ago and as everything worked smoothly it was decided to start the new machines.

These motors were built for 2,000 volts, and the power is taken direct from the 5,000 horse power generator in the big power house, step-down transformers not being used.

After the motors had been started they were not interfered with until morning. The test was thoroughly satisfactory and in a day or two the steam plant will be abandoned entirely.

MORE LIGHTING FOR LINCOLN PARK.

Bids for the recently advertised equipment of Lincoln park, with 240 additional arc lamps and machinery were opened last week and the following contracts let:

Engines: Buckeye Engine Company of Salem, O., two new engines, $5,925.

Arc machines: Electric Electric Company, $4,414.

Alternating machines: Westinghouse Electric & Manufacturing Company, $1,138.

Cables: Western Electric Company, 85,000 feet, at 9.7 cents a foot.

Conduit: R. & A. Coleman, Chicago, steel piping, $7.35 per 100 feet for 1½ inch pipe and $9 35 for 2 inch pipe.

The selection of arc lamps was left over pending some tests that are being made. These lamps when selected will be hung on the poles which were used at the World's Fair, the park commissioners having purchased them at $12.50 each.

Work will begin at once on the new equipment and the commissioners hope to have it ready for service early in June or not later than July 1st.

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ELECTRO-THERAPEUTIC DEPARTMENT.

ELECTRICITY USED IN MEDICINE.

It Cannot be Considered an Entity Like a Drug—Properties are Physical in Character.

The medical uses of electricity are ably classified and presented by Dr. W. J. Morton, of New York City, as follows:

"(1) I would suggest as a definition of electro-therapeutics, in a biological sense, that it is the transformation, by the law of conversation of energies, of electric energy into the energy peculiar to vital cells.

"(2) Electricity in medicine must be regarded not as an entity, like a drug, but as having a variety of 'properties,' such as electrolysis, cataphoresis, contraction of protoplasm, etc., each of which properties may be employed, singly or combined, to combat given morbid conditions or diseases.

"(3) Of the galvanic current it may be concluded,—

"(*a*) That strong currents depress nutrition of tissues and produce structural changes leading to physiological atrophy (twenty to a hundred milliamperes.)

"(*b*) That mild currents stimulate nutrition and produce physiological hypertrophy (one to eight milliamperes.)

"(*c*) That mild galvanic currents, pulsating or alternating, produce similar effects to mild continuous currents.

"(*d*) That the negative pole is specifically indicated in that large class of cases termed chronic inflamation where newly formed fibrous tissue or exudate occurs.

"(*e*) That upon the writer's theory—already accepted by several prominent physiologists—and observations, that catabolic or destructive elements in tissue uniformly present the sign of negativity—that is to say, are at their origin electro-positive (resembling the zinc of a voltaic cell), the negative pole is indicated to arrest the catabolism, the positive to augment it.

"(*f*) That the positive pole is rarely indicated, and, if so at all, upon the basis of an electro-tonic effect to produce sedation of neuralgic pain in superficial nerves.

"(4) Of the faradic current it may be concluded,—

"(*a*) That its main uses are to tetanize muscle and to cause sedation of pain.

"(*b*) That the tetanizing current as now employed to treat paralyzed muscles is injurious, since it enfeebles the muscle and causes atrophic structural changes.

"(*c*) That to strengthen or properly exercise a paralyzed muscle, a slow rhythm of the faradic current—about thirty waves to the second—should be adopted.

"(*d*) That in some spastic conditions of muscles (due to paralysis of an opposing group) the strong tetanizing current may be used to advantage to over-stimulate, and thus to fatigue, the muscle.

"(5) Of the franklinic current, or static electricity, it may be concluded that it is an adjunct of great efficiency in practice, since—

"(*a*) It evokes the usual nerve and muscle reactions.

"(*b*) It affords a most convenient means of stimulating the peripheral distribution of the nerves in the skin, producing counter-irritating, reflex, and other afferent impression effects.

"(*c*) It has a local perturbatory action (spark).

"(*d*) It produces profound alterations in the metabolism of the individual, increasing the natural waste-products and diminishing the toxic or by-products. For this reason it is specifically indicated in cases of malnutrition, whether local or general."

FUNDAMENTALS IN ELECTRO-THERAPEUTICS.*

Life is made up of motions and emotions. Some diseases and sicknesses are due to lack of functional motions. Electricity is a form of emotion biologically penetrating. Hence electricity is a therapeutic for diseases and sicknesses caused by lack of motional activities.

Partial list of normal biological motions taken in the order that they were suggested; if some seem out of place, think what life would be without them: (1) the cosmical and terrestrial motions of our planet; (2) sunlight; (3) sun-heat; (4) air-motions; (5) water-motions; (6) blood-motions; (7) nerve-motions and emotions; (8) osmosis; (9) crystallographical motions; (10) intestinal motions; (11) motions of secretions; (12) locomotions; (13) prehensions; (14) gastric motions; (15) electrical motions; (16) body-heat motions; (17) motions of sound connected with the ear; (18) of the chyle; (19) of the chyme; (20) of muscles; (21) of erectile tissues; (22) uterine motions in labor; (23) of smell; (26) of taste; (25) of protoplasm, so-called ameboid; (26) of deglutition; (27) of the osseous system, saltation, etc.; (28) cardiac emotions and ideas; (29) cephalic emotions and ideas; (30) motions connected with the will; (31) motions conneeted with love; (32) motions of ice-expansion; (33) sap-motions; (34) motions connected with alcoholic and vinegar yeast; (35) of urine; (36) fæces; (37) sweat; (38) growth; (39) gravity; (40) co-ordination; (41) cardiation, or heart thought; (42) secondary stomachic circulation; (43) evaporation, and so forth.

Partial list of diseases and sicknesses deemed due to lack of functional motions: all fibroid degenerations: all fatty degenerations and their masquerades, i. e, amaurosis; amyloid; angina pectoris; aphasia; apoplexy; apoplexy, retinal; arcus senilis; atheroma; Bright's disease of kidneys; Bright's disease of the lungs; broken heart; cataract; concretions, intestinal; debility, general; dementia; facial neuralgia; gallstones; heart-failure; hebetude; hemiplegia; hyperæsthesia; impeded circulation from embolism; insanity; melancholia; neurasthenia: paraplegia; paresis; pernicious anemia; puerperal convulsions; retinitis albuminuria; rupture of muscles; rupture of uterus; senile gangrene; shaking palsy; shock; softening of the brain; tic douloureaux, etc.

Electricity is a form of motion biologically penetrating; this was proved when a voltmeter and amperemeter showed a movement of index while a galvanic current was traversing a uterine fibroid eight to ten inches in diameter through needles penetrating four to five inches.

That galvanism is therapeutic is shown by the complete cure of a uterine fibroid which filled the pelvic cavity and most of the abdomen hard as a rock more than twenty-one years after the first application.

*By Ephraim Cutter, M. D., New York

HIGH-FREQUENCY EFFECTS ON BACTERIA.

At a recent meeting of the Academie des Sciences MM. d'Arsonval and Charrin read an interesting paper on this subject. The authors state that, having investigated the effects of the various forms of electrical energy on the bacteria themselves, they thought it would be interesting to ascertain the effects upon bacterial secretions. They allude to the experiments of Smirnoff and Kruger with continnous currents, and state that, owing to the difficulty of differentiating the electro-chemical from the purely electrical phenomena, experiments carried out by means of the electrolysis of solutions containing bacterial toxines do not yield reliable results. To eliminate electrolytic effects, and because they found from preliminary trials that seven coulombs of induced uni-directional electricity had more effect than seventy-eight coulombs due to an ordinary continuous current, MM. d'Arsonval and Charrin employed currents of extremely high frequency (225,000 oscillations per second, according to Thomson's formula) derived from condenser discharges. The average strength of the initial discharge current was 50 amperes; the mean value of the current traversing the toxine solution was 0.75 ampere, and the mean current density was 0.250 ampere per square centimetre. The experiments made, show conclusively not only that the toxines

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are greatly weakened by exposure to the action of high-frequency currents, but that the toxines so weakened may be used to render persons immune. Diphtheritic and pyocyanic toxines were investigated. A quarter of an hour exposure to electrical influence sufficed to diminish the strength of the toxines by about fifty per cent.

AN ELECTRO-THERAPEUTIC PRESCRIPTION.

The suggestion of galvanism in the vomiting of pregnancy has been repeatedly referred to in these pages, but the following prescription given by M. Champetier, is so exact and definite that it would be worthy of re-publication for those points alone, even if it were not good practice—which it is.

M. Champetier reports five cases in which the irrepressible vomiting of pregnancy was relieved by the application of galvanism. The positive pole is placed just above the right clavicle between the two portions of the sterno-cleido-mastoid muscle, the negative electrode being placed at the umbilicus. The strength of current employed was eight to ten milliamperes, the length of application from fifteen to thirty minutes. This method is an old one, but latterly seems to have been rather lost sight of.

ROENTGEN RAYS ARE MENTAL JUGGLERY.

Professor David Starr Jordan, of San Francisco, has undertaken to dissuade the people of the slope that Roentgen's rays don't amount to much anyway, and he defines the discovery as "photography of mental images." He says that even if Roentgen's discovery is all right and bona fide—which he doesn't admit—it isn't a marker to what the great Odin used to do some centuries back. This is the way Professor Jordan puts it in the San Francisco *Bulletin*:

"Mr. Inglis Rogers and other physicists of the impressionist school are now prominent in the newspapers on account of the supposed relation of their achievements to the discoveries of Professor Roentgen. Roentgen, and since him many others, have obtained shadow photographs from invisible light vibrations connected with the so-called cathode rays. These light waves passed through matter which is nearly impervious to the ordinary vibrations. Mr. Rogers has produced an impression on the photographic plate by simply gazing on it in the dark. Others claim to do the same by gazing only with the mind's eye, giving a photographic image of the subject of their thoughts. By this means they produce definite chemical action where no material basis for such action exists.

"Astonishing as all this is, greater works were done in the same line centuries ago. The sages tell us that when Odin and his friend tried to secure the golden mead of the giants, they found it locked up in a stone house. Then they sat down and gazed at the house all day, until by this means they had bored a small hole through the rock walls. This done by concentrated psychic effort, Odin had only to take the form of an angleworm and crawl through the hole to secure the mead. This he did, and, resuming his own form, carried it away with him to Asgard.

"This seems still more remarkable than any of Mr. Rogers' achievements, because Odin used neither lens nor photographic plate, and recorded his psychic impressions on a bare stone wall. Moreover, the record of his work is better authenticated than that of the recent impressionist photographers. If any one doubts, he will find anywhere the materials to try it for himself. Moreover, the old mythology rests on honest facts of nature. The new mythology allows craziness to obscure its plain lying.

"Many a man passes for a fakir who is really only a lunatic."

Electric power is being put into the United States assay office at Helena, Montana. There will be a ten horse power motor for running the blowers. The power is more than is needed at present, but its sphere of usefulness may be extended in the future.

THE CONDUCTIVITY OF ALUMINUM.

Lord Kelvin has announced, through the medium of a paper written for the London *Electrical Review*, by Mr. G. L. Addenbrooke, that the conductivity of aluminum is 68.5 per cent of that of pure copper.

The usual conductivity, as given in the books, hitherto has been 56 per cent that of copper. Lord Kelvin's research has, therefore, raised this by 21 per cent so that the conductivity of a wire of pure aluminum of the same section, instead of being a little over half that of a copper wire of similar section, is more than two-thirds the conductivity. Consequently, the diameter of an aluminum wire of the same conductivity as a given copper wire will be only 15 per cent greater, or less than one-sixth greater than that of the copper wire. This is a small fraction, and it is evident that for such a small increase of diameter the extra cost of insulating aluminum conductors to the same thickness as copper ones, and to secure the same conductivity, will present no serious obstacle.

Looked at in another light, copper is about 3·3 times the weight of aluminum; on Lord Kelvin's figures the conductivity of wire of equal weights of copper and aluminum wire of the same conductivity as a copper one would be four-ninths of the latter, or considerably less than one-half.

It would be difficult to say what extra cost would be entailed in manufacturing aluminum of this purity, but it may be assumed that before long the resources of metallurgy will be equal to it at a moderate cost.

As aluminum is just as pliable and easy to work as copper, it goes without saying what an advantage it would be in constructing heavy cables, and how much less strain on the insulating material it would impose. For overhead conductors, for the supply of power the advantages of obtaining a conductor of equal conductivity, with a trifling increase in diameter and of half the weight, are also manifest.

As a conductor, aluminum is now about twice as costly as copper; but as by the electrolytic process the price has already been reduced in eight years from 90c. per ounce to 35c. per pound, it is abundantly clear that, with the inevitable improvements which are taking place, the difference in price between aluminum and copper, which still exists, will be more than obliterated before long.

ELECTRIC COMPETITION IN CHICAGO.

The Rock Island Railroad's suburban service, in order to meet the sharp competition of the Wentworth avenue trolley line of the Chicago City Railway Company, has cut the price of ten-ride commuter's tickets to 75 cents. This cut applies to Englewood, Normal Park and Eggleston. Within the last six months the company has cut the prices on this class of tickets 35 cents. There appears to be no question but that a 5-cent fare for commuters will be in force as soon as track elevation on this road is finished to Sixty-third street.

Clark street and Wentworth avenue trolley lines have added to the number of cars which they have now in service. A majority of the cars now run a minute and a half apart. None are more than two and one-half minutes apart. A new rule has gone into effect that every other car south bound from Washington street shall stop at Sixty-ninth street and Wentworth avenue instead of going through to Seventy-ninth and Halsted streets. Motormen who have been making five runs a day, aggregating 110 miles, have had added a sixth run. The line is not yet accomodating the traffic and the usual number of people have to stand up.

A French exchange heads an article "Electricity in the Chamber of Deputies." Of all places in the world, we should say the French hall of legislation the least needed electricity. It is a sort of "automobile" institution, and doesn't need machinery.

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HERMANN L. F. VON HELMHOLTZ.

German Physician and Scientist. Born 1824, Died 1895. Inventor of the Ophthalmoscope. With Joule and Others Developed the Principle of the Conservation of Energy. Determined Mathematically the Effect of Self Induction upon Current Strength.

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The Electrical Journal.

Vol. 1. CHICAGO, APRIL 15, 1896. No. 22

STUDY OF ALTERNATING ARC.

Photographic and Prismatic Views of the Arc of an Alternating Current Lamp Demonstrate Several Features of Interest.

COMPARISON WITH DIRECT CURRENT ARC.

When a direct current of proper volume is caused to pass between the tips of suitable carbons, there is produced the phenomenon called the arc light. Generally the direction of the current flow is such that the upper carbon is the positive, and the lower the negative electrode. In order to produce a quiet and steady arc, the positive carbon may have a soft central core to aid in the formation of the crater from which the greater part of the light is emitted. The negative carbon may be cored or solid.

If we examine this arc light very carefully through dark glass, either smoked or colored, or better still, project an image of the arc on a white screen in a darkened room, using a good achromatic lens of large aperture and moderately long focus, we shall see pictured out a beautiful but inverted image of the arc in correct colors and intensities.

Knowing the direction of the current, we notice that the positive carbon has a very sharply defined crater of dazzling whiteness of about ⅛ or ¼ the diameter of the carbon itself. From the crater the somewhat rounded point of the carbon diminishes in brightness, and finally verges into the dark unchanged carbon. Upon this heated carbon point the evidence of combustion is plainly seen in shape of changing surface and falling or accumulating ashes or secoriæ, while about it may be seen the flames of the burning carbon. The appearance of the negative carbon is quite different and clearly characteristic. The point is sharper, often with a little tip at the extreme end, while its base has a sort of crown or wall of ashes. The little tip is of whiteness equal to that of the crater of the positive, but very small indeed. Below this tip is the hot pointed carbon which, however, is not nearly as hot as the positive.

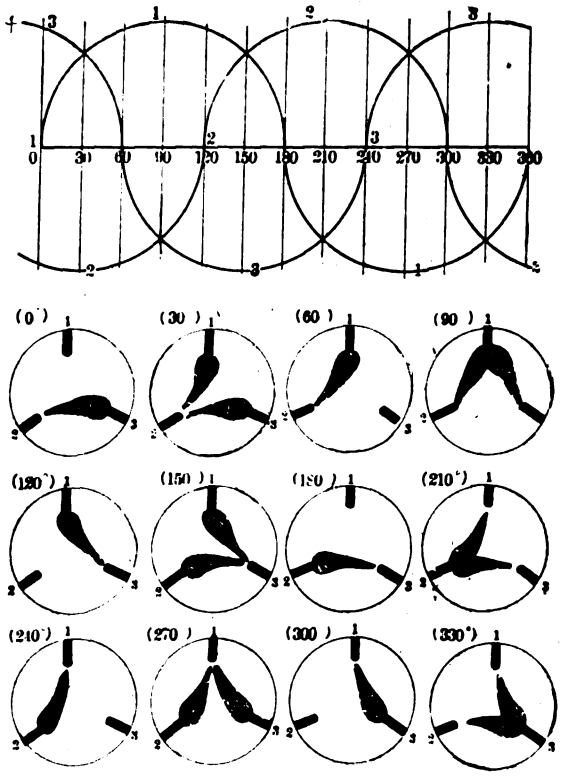
In the space between the two carbons is the bluish violet light of the incandescent vapor in the path of the current. This is the arc itself, relatively non-luminous and in volume conical. The base of this blue cone is as large as, and is in contact with the crater, while the apex just touches the white tip of the negative carbon. Surrounding this core are several layers of gases of various shades of blue and yellow, and the flames of the burning carbons. The light thrown out by this combination of causes may be considered as coming from four sources. By far, the greater part from the white hot surface of the crater on the positive carbon, a much lesser amount from the little white tip of the negative; less than this from the carbons considered simply as two red hot sticks, and a very small amount from the hot gases. It is evident that a large part of the total light will be thrown downward.

Upon stopping the current, the heated carbons glow for some time; the positive is, however, very much hotter than the negative and keeps hot longer.

If, after the carbons have become cool, an alternating current is caused to pass between them, and sufficient time allowed for the points to become settled into their normal shape, it will be seen that the arc is naturally different in appearance from the direct current arc. Both carbons will be of the same shape, having rounded points, each with a small luminous crater, from which is emitted the greater part of the total light of the arc. Both carbons will show similar signs of combustion with the accompanying flames and ashes, and the light will be thrown upwards as well as downwards.

The blue arc between the two craters will appear as a band of nearly the same width in all parts, while about it are the several gaseous envelopes of different degrees of intensity. Upon shutting off the current, both carbons will be found of the same degree of luminosity and heat.

Somewhat more than a year ago, I wished to demonstrate to



the senior class in electrical engineering during a lecture I gave them on alternating current phenomena, that, although when examined by means of a large projected image upon a white screen in a darkened room, the alternating current arc appeared to be as steady as the direct current arc, and the light was thrown equally upwards as well as downwards, yet there were very great fluctuations in the light due to the intermittent heating of the carbon points.

The method chosen was the stroboscopic, which has given us at the Institute of Technology most excellent results in the hands of various experimenters while investigating the movement of transmitter electrodes, telephone diaphragms, tuning forks, vibrating strings, and the like.

*Paper read by William L. Puffer, March 25, 1896, before the American Institute of Electrical Engineers.

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A hand regulating arc lamp was placed in a lantern, with a large achromatic lens so adjusted as to make an image of the arc some ten feet long on the screen of the lecture room. A transfer switch and suitable rheostats were arranged so that either a direct current or an alternating current of about fifteen amperes could be used. At a convenient point a disk of about eighteen inches in diameter, in which were cut eight narrow radial slots, was placed so that the beam of light was interrupted as the disk revolved. The disk was fixed to the shaft of a direct current motor whose speed could be adjusted very closely by a rheostat in the armature circuit.

As the alternator used was a 125-cycle dynamo, and the disk had eight slots, the stroboscopic effect would be produced when the light of the arc would be allowed to pass at a frequency very slightly more or less than that of the dynamo, or $\frac{125 \times 60}{8} = 937\frac{1}{2}$ revolutions per minute of the motor armature.

Suppose, for example, it ran at 937 revolutions per minute, then, counting from the time when the current in the arc was zero, each receding flash of light would be $\frac{1}{120}$ part of a complete alternation behind the preceding one, and owing to the persistency of vision the arc would be seen on the screen, as if the alternations had been so reduced in speed that it took two seconds for a single alternation of the current.

An attentive watching of the image as the current alternates is now highly interesting and instructive, and can only be seen to be fully appreciated.

It is clearly shown that the alternating current arc is a sequence of direct current arcs, alternating in polarity, and that each wave of current produces very clearly and distinctly all the attributes of the direct current arc.

The hot positive carbon with its white hot crater, from which extends the fan-shaped blue light of the arc to the small white tip of the colder negative carbon, will be seen to die away, and all light goes out except the glow of the red-hot carbons, and then light appears again with the current reversed.

Early in November last the subject was again taken up, with the very efficient aid of Mr. R. R. Lawrence, a post-graduate student in electrical engineering at the Massachusetts Institute of Technology, and rapidly developed with such beautiful results that it was decided to exhibit publicly before the Society of Arts, which was done some little while after, at the regular meeting of January 2d, 1896.

We first attempted to take a set of instantaneous photographs of the arc at different periods of an alternation, and by the use of a pneumatic shutter, and a progressive motion of the lens, obtained some very sharply defined pictures. After many trials, this was given up, because of the practical impossibility of timing the exposures with respect to the alternations, and we decided to use a disk with half as many slots as there were pole-pieces on the dynamo, and to drive it by the shaft of the machine itself.

The dynamo available was one giving a three-phase 500-volt current with a frequency of about 60 cycles. Two wires only were used to give us the current required.

A somewhat long, light shaft, carrying at one end the disk, and at the other a positive mechanical clutch, was mounted in line with the armature shaft. As the clutch could only be thrown in when the two shafts were nearly equal in speed, a small motor was placed so as to bring the disk up to speed when the clutch was thrown in and the motor belt removed.

The disk was held in place by a frictional clamp disk on the shaft. A graduation and reference mark served to measure angular change of disk on shaft, and therefore of slots with reference to the pole-pieces or alternation of the current.

The arc to be tested was put in a boxing to keep away air from the currents close behind the disk, and a camera with a roll holder in front of the disk. With this arrangement the arc as seen was perfectly steady at any part of the wave that corresponded to the position of the disk on the shaft, and as the process of stopping, setting and starting the disk was very rapid, the roll holder being in mean time turned, many pictures could be taken in a very few minutes.

Generally it was not necessary to take more than twelve exposures in order to get a series showing clearly the changes in light intensities during a single phase.

We found that it was about as instructive to watch the appearance of the arc on the ground glass of the camera, and far more beautiful. In this way we examined both the effect produced in the arc by change in the voltage of the circuit, the current being kept constant by alteration of the resistance.

For example, with 500 volts, and a large non-inductive resistance in series with the arc, it was plainly evident that the current wave was approximately sinusoidal, as the time of extinction of the current, as indicated by the blue band of the arc proper, was very short, and the rise and fall of the current gradual and with no irregularities. This is to be expected, as the back E. M. F. of the arc is small compared to the voltage of the generator, and the circuit as a whole is non-inductive.

The opposite condition was realized by using a lower E. M. F. and regulating by a reactive coil. The time of no current was longer, and the current appeared to jump to its maximum in an exceedingly small angular time. In this case the arc was not steady, showing clearly to the eye that the succeeding waves of current were not alike either in form or current value, and also that the angle of lag was constantly changing. This fact has always prevented an accurate plotting of wave forms by the instantaneous contact method, and although known to exist, was never before actually seen.

A very pretty double arc was arranged by using three carbons and wiring two circuits, each with current regulators, in such a way that the arc was the common junction, and one carbon was of one polarity, while the other two were of opposite polarity. With wire resistances in each side, there was nothing peculiar to be noted other than the effects of the junction of two currents, but when the resistance in one circuit was gradually cut out, and equivalent induction cut in, there was at once visible evidence of the lag of the current, together with the change of shape of the wave and the unsteadiness before noted. Owing to the long time of no current in the inductive side there were times when even with considerable lag there were actually no visible traces of current between either points. This effect was dependent on adjustment of current strength and inductance as well as voltage. The sequence of currents and polarity in this arc was most beautifully brought out when the disk was disengaged from the shaft, and driven by the little motor at a rate very slightly less than the dynamo.

We found that work in the immediate vicinity of the dynamo was not very desirable, owing to air currents and excessive vibration, so we arranged a combination of motors that will produce at any distance from the dynamo all the desired results.

A very nicely balanced brass disk with four radial slots in it was attached to the armature shaft of a Holtzer-Cabot synchronous induction motor of eight poles. The pully of this motor could be driven by a light belt from a self-starting induction motor of the same make, which is, however, not quite synchronous under load. By trial the two pulleys are wound with rubber tape until their ratio is such that the brass disk will be uniformly driven at a speed a trifle above synchronism, and the arc light can be seen through the slots to pass through the alternation at a desirable rate.

By a single movement of a switch, the non-synchronous motor is cut out, and the synchronous cut into circuit when the armature drops into step with the dynamo, and the arc is instantly seen as fixed, the belt is thrown off or left on, as desired. These armatures may be on the same shaft, if necessary. The synchronous motor does not stand on its base, but rests on the turned outside of its bearings in pillow blocks which are attached to a suitable base frame.

Concentric with the shaft and firmly attached to the motor is a brass gear, six inches in diameter, and on it a graduated circle. On a lever pivoted so as to be thrown to or from the motor gear is a small spur gear with a milled head for turning.

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Turning this head will evidently cause the motor to slowly rotate about its axle, and as the armature must be in step with the dynamo, and as the turning of the motor changes the position of a given pole piece relatively to the arc light, it follows that any part of the alternation of current in the arc may be seen on the screen, and as the motor has eight poles, a quarter turn or 90° on the graduated circle corresponds to a complete cycle in the arc.

The picture of the arc can then be photographed, measured, or in any way studied at leisure in any phase relation, as, for example, when the top carbon is positive, or when there is no arc at all and only dull red carbon points visible.

In this way we have seen single arcs of high and low E. M. F., long and short double arcs, arcs with much inductance in circuit, Jablochkoff candles, arc between a ring and a point within, the spinning arc between the ends of a carbon cylinder and a concentric carbon within, with a magnetizing coil around the inner carbon and the like.

One of the most beautiful arcs investigated by us visually and photographically was a rotary arc made by the use of three carbons in the same plane, at angles of 120° apart and wired up as the juction point of an external Y load on a 500-volt 60 cycle three phase generator. Non-inductive resistance was used in the circuit, and the current used in one leg of the Y was 10 or 15 amperes.

Twelve photographs were taken at equal intervals of 30° in an alternation of the current in one wire. Fig 1 shows very clearly the relation of the current waves from the different carbon points, and the curved, fan-shaped figure indicates the position and direction of the bluish arc at the corresponding angle. The base of the fan rests on a positive carbon which has a white-hot crater and all the appearance of the positive carbon of a direct current arc, while the tip of the fan rests on the white spot at the end of a navagative carbon.

It will be seen at 0°, for example, there is no current on carbon 1 and that 2 is negative and 3 positive, the blue fan-like arc curve from 3 to 2: 30° later, 2 is still negative and 3 positive, but that an equal arc is now playing from 1 to 2. At 60° 2 is still negative, 1 positive, but there is no current on 3 At 90° the appearance is somewhat like 30°, except that the signs are changed, and the point with the double current is necessarily much whiter, it being now positive. And so on through the changes of the complete wave.

This three-phase arc, when seen while the disk is running non-synchronously, is the most beautiful of any studied, and may be seen according to the different length of arc and the divergence of the disk from exact synchronism, either as a band of blue light which seems to be progressively travelling over the three sides of a triangular path, or as a rapidly spinning star of blue light, being in fact a rotary arc.

The three-phase arc is less noisy than the single phase, and its light is steadier and has less variation in its total intensity, owing to the fact that the current never stops, and there is always a positive carbon. Three cored carbons, placed parallel side by side, with slight magnetizing coils to keep the arc at the ends of the carbon, will give a very satisfactory light in the direction away from the tips, and may be used when it is desirable to throw the light all in one direction.

Four carbons at 90° apart, each with a suitable resistance in series with it, and connected to quarter-phase tap wires on a Gramme ring or other generator giving quarter-phase circuits will also produce a rotary field arc of great beauty and interest.

Study of these arcs is still going on at the Institute of Technology under my immediate charge, which will, I hope, produce results sufficiently interesting to justify a second paper at some later date.

TELAUTOGRAPH IN ENGLAND.

The St. James *Gazette* is authority for the statement that the Gray telautograph is to be adopted by the National Telephone Company, in addition to its ordinary service.

STREATOR MAKING CLOSE BARGAINS.

The offer of C. A. Ray, of Louisville, Ky., to give to the city of Streator a lot of apparatus for the fire department is one that ought to be taken up. Mr. Ray's offer is to give the city an electric annunciator for the ringing of the fire bell, for $225, five new fire alarm boxes, at $80 each, and gongs to put in the houses of the volunteer firemen for $200.

That is a snap. The electric alarm for the bell alone is worth $450. The fire alarm boxes are worth $125 each and there is no discount for their purchase in large numbers, and the gongs usually sell for $35 each. The city of Streator has at present a poor system of fire alarm. If all the boxes could be repaired, and Mr. Ray's offer is to repair all of them and put them in good order, as well as put in the new ones, then it would be better. And an electric alarm sent in from a box. which would ring the box number four times on the big bell in the tower, would be a big improvement over the present system of a general alarm, which gives no one any idea where the fire is located.

Mr. Ray offered the council this lot of material, will send a man from the company office here to do the work, and give the city a year to pay for it all in, provided the offer is accepted before April 15. The matter was referred to the fire committee of the council and what action that committee will take on it, is one of those things no one can find out, but the wisdom of their accepting the offer is apparent to all, it would seem.—*Streator* (Ill.) *Times.*

CUTTER COMPANY'S FINE CATALOGUE.

The Cutter Electrical & Manufacturing Company, 1112 Sansom street, Philadelphia, announce that they have in their printer's hands a beautifully illustrated catalogue of their C-S Flush Switches and accessories. This promises to be the most elaborate catologue devoted to this subject, and will be sent, post paid, to all interested. They are also preparing an illustrated catalogue of the I-T-E-Circuit Breaker, about which we are hearing favorable comments on all sides. This will be ready early in May.

WESTINGHOUSE COMPANY BUYS COPPER MINES.

Many hundred tons of copper are annually used by the large electrical manufacturing companies for wire and electric machinery. So great is the consumption of the Westinghouse Company that it has purchased the largest group of copper mines in Arizona and obtained possession of the International Smelting Company's plant near by, which will be enlarged to supply the extensive demand of this one establishment for copper for manufacturing purposes.

GORDON-BURNHAM BATTERY IN GOOD HANDS.

The Metropolitan Electric Company have taken the exclusive Western agency for the Gordon primary battery, which is manufactured by the Gordon-Burnham Battery Co. of New York. They are carrying a large stock of these batteries. The battery is the latest improvement primary battery on the market, and is found to give excellent service for railway signal devices, fire alarm telegraph circuits and other exposed points that require a constant battery with a minimum of attention.

PROBABLY MORE HIGH SALARIES.

The electric light plant seems to be a fair weather concern. Last evening when it was most needed the light went out. The cause is reported to have been low water in a boiler and when they pumped the water in it went in so fast that it "froze" the steam, and they pumped it so full that it ran out of the exhaust pipe. They have dischasged one of their engineers and put a lawyer in to run it.—*Hastings* (Mich.) *Journal.*

BUSINESS PUSH IN OSBORN.

J. A. Kurtz has repapered his barber shop and had electric lights put in. He desires to say also that he washed the windows.—*Osborn Local.*

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OUR LETTER FROM CHINA.

MISSION CATHOLIQUE, SHANGHAI, CHINA, March 3, 1896.

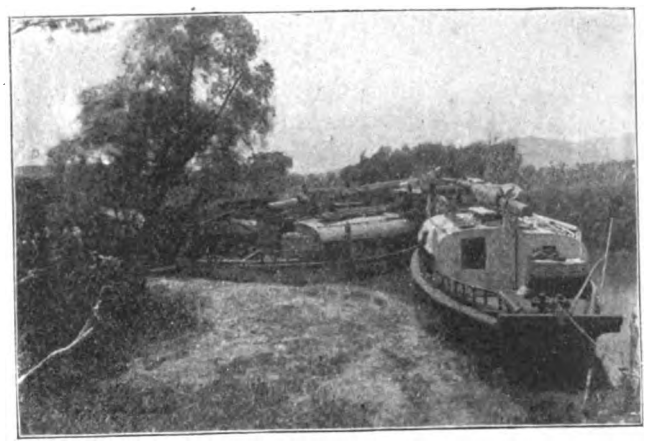
Special Correspondent of the ELECTRICAL JOURNAL:

The old electric lighting plant of Shanghai, China, is about to be moved into a new and more commodious building. It was established in its present rather cramped quarters by a private company, which sold out a few years ago to the Anglo-American municipality. The new site has been chosen on a spacious lot near the river, and a large building, erected under the direction of the superintendent, Mr. Price, is now nearing completion.

The plant is not a large one, consisting of only six dynamos for street and hall lighting, and three dynamos for incandescent lamps. The street lamps number only 110, and about 50 more for theaters and stores complete the number of arc lights. Five dynamos are from the Brush Electric Co., of Cleveland, Ohio. but at present all the dynamos and other machinery and gearing are furnished by the Brush Electrical Engineering Co., of London, Loughborough and Vienna.

PRESENT TRANSPORTATION IN CHINA.

Though the plant is small, it will have room to expand in its new building, and as the settlements on the foreign concessions are growing rapidly, the demands for electricity are becoming daily more imperative. The foreign population of the settlements for last year was 6,420, which, together with the native population of 293,183, gives nearly the round sum of 300,0 0, as the total population upon the concessions. The native city though not large in extent, is estimated to contain upwards of 500,000 inhabitants. The price of real estate upon the concessions and in the neighborhood of the Chinese city has increased considerably within the last year, and so many buildings are going up that in many instances work has been stopped for the want of brick. Upon the American concession, which, owing to its uncramped position along the river, is the freest to expand, new streets are being laid out and rapidly built up, just as in one of our growing cities at home. Cotton-mills and silk-filatures and other factories are raising their smokestacks in yearly increasing numbers, and native merchants are vieing with the foreigners to invest their capital upon the concessions, in order to have their share of the fruits of Shanghai's growing industries.



PRESENT TRANSPORTATION IN CHINA.

Many of the factories are already provided with electrical plants of their own. Moreover, the French municipality, which is independent of the English and American settlements blended into a single municipal government, is about to install an electrical plant for its own street lighting and other purposes.

Thus far electricity has been applied to no use but lighting in Shanghai, besides the telegraphic and telephonic services, but there is prospect that it will soon serve for traction as well. There is an American gentleman here at present promoting an electric tramway, proposed to traverse the principal streets of the settlements and to run out to the limits of the American concession, to a bend of the river, known as the point. I understand that this is the second time that Mr. Hunt has come out here in the interests of electrical traction, and though he may still have to put up with some delay, it is not probable that he will meet with another disappointment.

The ordinary mode of transit upon the concessions is the jinricksha service. The jinricksha is a light little gig drawn by a man, and it was devised and first used by the foreign residents in Japan, about a quarter of a century ago. It is a convenient and comfortable and, for a short distance, a sufficiently rapid little vehicle, and its use has spread from Japan to all the ports along this coast as far south as Singapore, and even around to Columbo. Even the natives patronize it largely in the foreign settlements, as it is a decided improvement upon their own wheelbarrow, and so much more rapid than the sedan chair.

In China cities, the chair is the only mode of transit that the narrow, crowded streets permit of, and out of the cities, at least in the south of China from Shanghai down to Canton, the roads, or rather paths, are not practicable for any vehicle but the wheelbarrow. The Chinese wheelbarrow is so constructed that the burden, if divisible, may be placed before and behind and on both sides of the large wheel, and about on a level with its axis. That arrangement permits of an immense load being wheeled by a single man. The wheelbarrow is much used by the natives even upon the concessions, as it is very convenient for a person with a large bundle to balance him, and it will hold two persons and permit of a chat on the way, while the jinricksha holds but one.

The wheelbarrow and jinricksha, so convenient for short distances, will not be quite driven out of the field by a rapid tramway, but they will lose most of even their native patronage for longer distances. The native prejudice against western modes of travel is only superficial, as was sufficiently proved by the experience of the little narrow-gauge steam road that ran for some time from Shanghai up to the mouth of the river. The Chinaman is too shrewd and practical not to know a good thing when he sees it. A railroad is now projected from Shanghai to Soo-Chow, an important city some eighty miles inland, recently

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opened to foreign merchants by the Japanese. We may hope soon to see electricity and steam supplanting, at least in part, the wheelbarrow and the jinricksha, and for longer distances, the leisurely canal boat and the scrubby Chinese pony.

Yours respectfully,

WILLIAM HORNSBY, S. J.

POLITICS AND MUNICIPAL LIGHTING.

Communities all Over the Country Making their Electric Light Business a Feature of their Campaign.

Some of these men have been open and avowed enemies of the municipal plant project from the beginning of the enterprise until a few days ago, while others of them, although not so open in their opposition, have persistently ridiculed the scheme and predicted that it would be a failure. After they were nominated for aldermen and began to ask people for votes, they were surprised to find that the people cared more about their attitude toward the municipal plant than for any other issue, and then these men executed a sudden flop and declared themselves friends and supporters of the municipal plant because they discovered that otherwise there was no possible chance of securing election to the city council.

The question each voter must determine for himself today, when he goes into the booth to mark his ballot, is whether he is willing to intrust the completion of the municipal plant project to men thus converted to the enterprise by compulsion, for the sake of office, or whether he will continue in charge of this project the men who have made its success possible and who can be trusted to carry it forward to successful completion.—Springfield, Ill., *Journal.*

THE WOMEN TO THE FRONT.

For the first time in the history of Irvington the women were given an opportunity to vote yesterday. The votes were not cast for the purpose of electing town officers, but to determine whether it was advisable to put in an electric light plant or not, and whether it should be owned by the town or by individuals. The election, to a certain extent, passed off quietly. No blood was shed, but there was much bitter feeling between some of those in favor of electric light and those opposing it. The lie was passed on two or three different occasions, but the friends of the excited individuals prevented any open hostilities. The total number of votes cast was 286. Of this number 205 were cast by men and eighty-one by women. For electric light there were 116 votes cast by men and forty-one by women, and against the proposition eighty nine by men and thirty-five by women, giving those in favor of it a majority of thirty-three votes. One hundred and twelve men and forty-two women voted for town ownership, and forty-two men and eleven women for private ownership, giving the former a majority of 101.—*Indianapolis Sentinel.*

SPRINGFIELD TOWN MEETING.

Little political significance can be attached to to-day's town election in West Springfield. The republicans elected two of the three selectmen, but party lines were not closely drawn. The vote for the selectmen was:

Loomis, rep. and dem., 582; Rogers, rep., 464; Mosely, dem., 406; Schmuck, rep. and dem., 386. The first three are elected. The vote for license was, yes, 182; no, 294. Last year's majority for license was 76. Fred H. Sibley was elected town clerk and treasurer, and Arthur A. Sibley and Clarence E. Smith school committeemen without opposition.

The most significant feature of the election was the vote of 440 to 124, in favor of the town establishing a plant for the manufacture of electricity for municipal use and sale.

An adjourned meeting will be held Wednesday to transact town business.—*Boston Standard.*

LEBANON'S HOT MUNICIPAL FIGHT.

This city is in the midst of the most bitter municipal campaign ever experienced here. About a month ago the council gave the Lebanon Electric Light Company a ten-year street-lighting contract at a rate considered exorbitant. An indignation meeting was held and it was decided to launch a citizen's ticket. In opposition to this the republicans have put a straight ticket in the field. The feeling has become very bitter and serious trouble is expected. A large force of deputy marshals has been sworn for duty on election day.—Chicago *Chronicle.*

MAY ADOPT MUNICIPAL OWNERSHIP.

At last night's meeting of the Borough Town Council a resolution was adopted instructing the proper committee to ascertain the cost of a municipal gas and also an electric light plant. Pending the work of this committee, no privileges for a similar purpose will be granted outside capitalists, who are endeavoring to establish plants here and who have already applied for charters—*Philadelphia Times.*

First and last the *Register* has bitterly and continually arrayed itself against the Capital Electric Company in its effort to secure to the city a light plant of her own. They object to the election of DeFraites, Hatch, Wheeler, Rippey, Steele, Miller and Phillips, not so much because they are republicans, but because they favor the "Municipal Plant."—*Springfield, Ill. News.*

The Capital Electric Company is entited to the hearty support of the council, as this company is doing for the city what the city could not do for itself. Vote for republican aldermen if you want the city to own this beautiful plant —*Springfield, Ill. News.*

The Howard bill empowering cities to erect their own electric light stations and to purchase existing stations has been favorably reported, with some amendments in the Ohio legislature.

Manshfield, Ohio, is advertising for bids for two engines and wo generators for lighting purposes. April 21st is the last day on the bids.

Peoria, Ill., is advertising for bids for lighting the city for the next two years.

MAKING SHOES BY ELECTRICITY.

The operation of shoe factories by electricity seems to be making steady headway. A few weeks ago we noted the equipment of the large Drew-Selby plant in Ohio with electric motors throughout by the General Electric Company. The same company is about to undertake the electrical equipment of the Norway Shoe Shop Company, of Norway, Me. Seven non-synchronous multiphase motors, aggregating 100 H. P., will be put in.

HOW FAST DOES ELECTRICITY TRAVEL?

The above question is frequently asked in every-day conversations, but is seldom answered to the satisfaction of the querist. Wheatstone says that the speed of electricity from point to point along a proper conductor is practically instantaneous. Various attempts have been made to ascertain the exact number of miles which the current will travel in a given length of time. According to the most reliable estimates which such experimenters have made, its speed is not less than 114,000 miles per second.

WESTINGHOUSE COMPANY TO INCREASE CAPITAL.

The stockholders of the Westinghouse Electric & Manufacturing Company will meet June 4 for the purpose of increasing the capital stock of the company from $10,0000,000 to $15,000,000. The Board of Directors announce their acceptance of an offer to purchase from the company $5,000,000, par value, of the company's second preferred or assenting stock, on terms which they consider highly advantageous to the company.

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ST. LOUIS SUBWAY PROBLEM.

Suggestions, Financial, Legal and Mechanical That May Help To a Solution of a Badly Mixed Question.

ONE COMPANY SHOULD BUILD AND SUBLET.

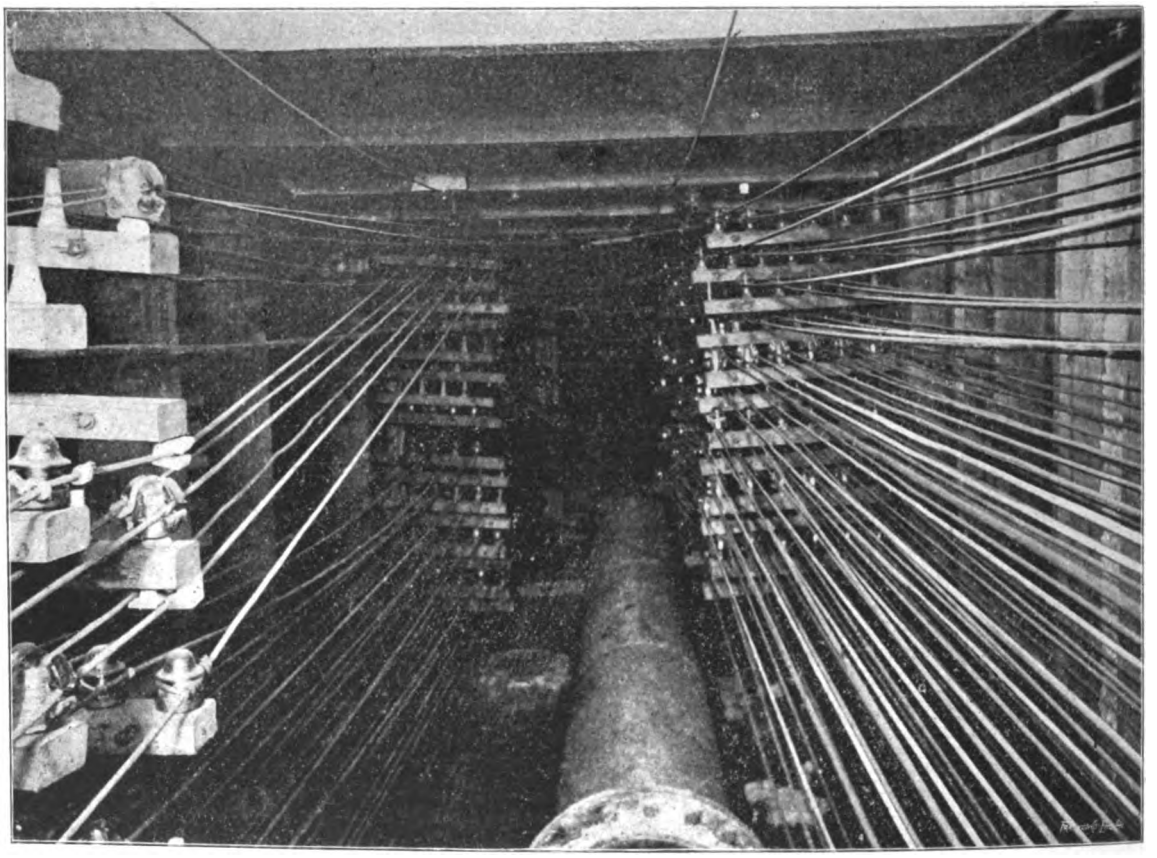
In its last issue, THE ELECTRICAL JOURNAL suggested editorially, some of the difficulties surrounding the St. Louis subway problem, and promised to elaborate on the subject in this issue.

There are three phases of the question, namely, legal, financial and mechanical in the order of their prominence under existing conditions.

We shall deal lightly with the legal aspect of the case, as that is the province of City Counsellor Wm. C. Marshall, and the legal advisers of the various corporations. Suffice it to say that the supreme court decision in the Sutter case—if sustained by the full bench—makes it necessary for "a wire using company" to construct, maintain and operate any subways that may be authorized. The Laclede Gas Light Company's contention that its original charter gave it the right to build a subway for electric wires, need cut very little figure in this article If the supreme court at Washington decides in favor of the company, the way will be open for the Laclede Company to make arrangements with the electric lighting companies for the use of a subway to be operated under that charter. But the lighting companies care very little about a separate subway, if other arrangements can be made for them that will not be likely to throw down the bars for the rushing in of a lot of new franchise-seekers who may have the same subway rights as themselves.

Right here, it may be stated, that the main objection on the part of existing companies, to a common subway is that such an arrangement would allow new companies to come in with new franchises, and be exactly in the same shape as themselves in regard to facilities. The importance of this feature of the case may be understood, when it is remembered that the Western Union relies not at all upon patent advantages, and altogether upon its present equipment, rights of way, and contracts with corporations for service between points where there are at present no competing lines. Give a new company the right to enter St. Louis in competition with the American District Company, for instance, and provide a run way for its wires, on payment of an annual rental only and without the large original outlay for the building of a separate subway, and a very small amount of capital would set up a formidable competition. The same condition would be true of the Missouri Bell Company, which is already threatened at frequent intervals with competition at the hands of one or other of the so-called independent companies.

So that it will not be wide of the mark to say that provision will have to be made for only those companies who are now doing business, and under conditions that would preclude the occupancy of a common subway by any "Tom, Dick or Harry" Company that could muster enough money to pay for a charter and enough friends or influence to get a franchise, or the citizens of St. Louis will find every existing interest? Western Union, Postal, Bell, Light and Power, arrayed against a common subway. I am not a friend to monopoly in the objectionable sense, but there are certain rights of capital, and I believe the law-making people and their representatives in law-making bodies are charged with the defense of these rights, and their protection from brigandage of every sort, whether it be in the uncloaked form of petty larceny or that more vicious species of out-lawry known as blackmailing competition. I believe, therefore, that perfection of plans to accommodate existing interests, with provision for their elaboration commensurate with the prospective growth of the city for the next twenty-five years, would be desirable from every legitimate standpoint.



WORLD'S FAIR SUBWAY—BUILT OF WOOD.

We have thus come directly down upon the next most important phase of this subject, the financial and economical.

It may be fairly taken for granted that the state supreme

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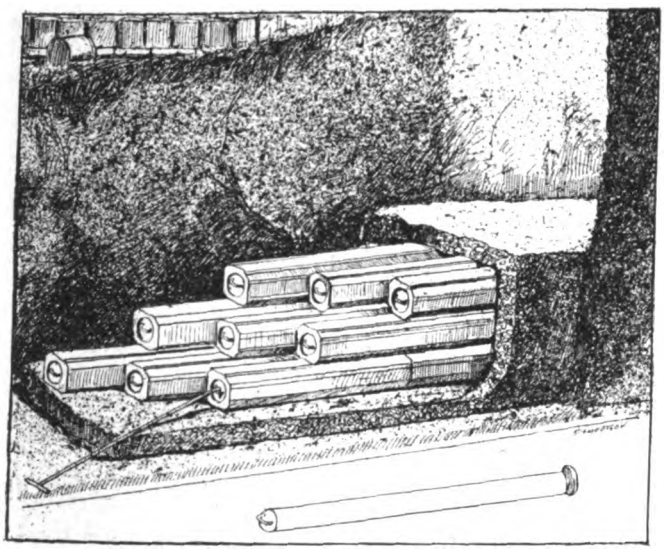
court will sustain the decision of its committee in the Sutter case, and hold that the city of St. Louis has no right to grant to a private corporation, for private purposes, a franchise to occupy the public streets, and that such rights may be granted only for public purposes to a corporation having the functions of a public carrier. This would make it necessary for the wire-using companies to build their own separate subways, or for one of them to build a system; and I believe there is legal precedent for the contention that one such company may lease or rent pole rights or space to any other such company. At least that custom is practiced in most places where two or more companies run over the same territory. There would seem to be no reason, therefore, to suspect a legal complication in the event that one of the existing companies should build a comprehensive system large enough to accommodate all, and lease space in it. It seems to me that such a plan is easily capable of arrangement as

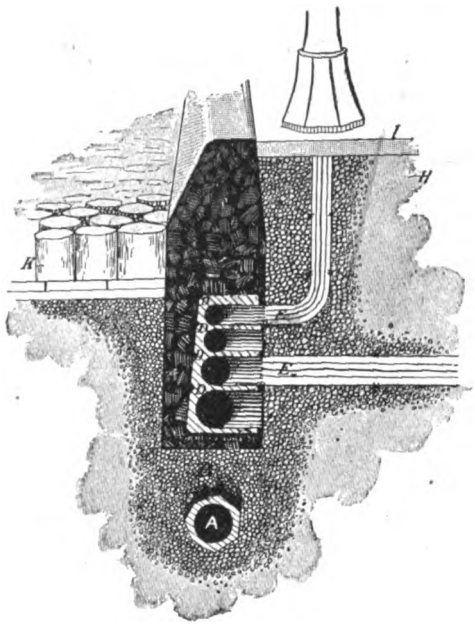


to details. And this brings us to the reasons why such a scheme would be desirable from the standpoint of all concerned, which leads us to the latest phase of the subject, namely the mechanical and technical aspect.

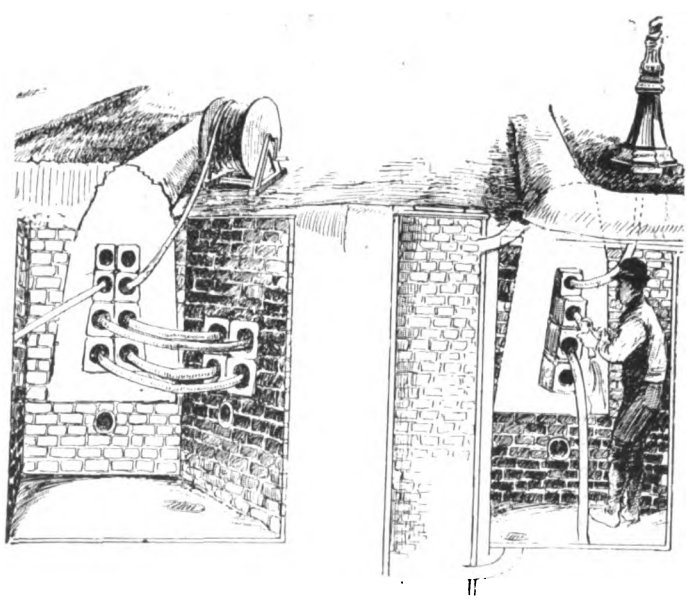
The average width of the streets of St. Louis, from curb to curb, is thirty-six feet. We are told by the Board of Public Improvements that fourteen feet in the middle of most streets must be left inviolable for street car purposes. We are further told that one whole side of every street, or at least half of all the remaining space must be left for water, gas and sewer purposes. This makes fourteen feet, and eleven feet, unavailable for electric subways, leaving eleven feet for these purposes. There are now at least eight of these electric wire users. They cannot operate in less than two and one-half feet each, even for a small subway. So the incompetency of the available space will be readily understood. The question of space, therefore would seem to urge a common system. In Chicago, where each company has its own subway, some of the streets are occupied to their utmost capacity, and the authorities must soon meet the demand for additional space. In some parts of that city, the space under sidewalks is occupied, but this is unsatisfactory and not wholly without danger on account of electrolytic action.

We will not undertake to settle the question of the technical possibility of light and power circuits and telephone and telegraph circuits occupying the same subways, or indeed the same side of the street without prejudice to the service of the latter two. We have no precedents to urge either way, but we are fully aware of the difficulties in the way of the control of induction. I believe firmly, however, that in an adequate system, these two varieties of current could be separated sufficiently to overcome any inductive influences.

Other questions being laid aside for the time being, the next consideration is that of a comprehensive system suitable for all conditions of service. In the illustration of a main service subway herewith, we have the system used for all carrying purposes at the Columbian Exposition. On that occasion it was built for temporary use, and was wholly of wood. A perma-



nent structure of the kind would not be costly—comparatively speaking—and would be by far the best for carrying the heavy down-town circuits. I would build this form of construction in the form of a cross, one line extending along Twelfth street, from the Mill Creek Valley to Cass avenue, and the other from Broadway to Jefferson avenue, out Olive, Pine or Chestnut. This subway, beside being large enough to accommodate any number of any kind of wires, is readily accessible to workmen, easily ventilated, and its first cost over plain tubing is its only disadvantage. The location of these mains will make them



easily within reach of the mains running from the Western Union, Bell Telephone, Postal, and the two lighting companies' generator or operating stations.

There are several varieties of conduit that may be used to carry lines from these mains. In the illustration, are two of these forms of tubing that contain most of the features of the others. Figure —— is plain vitrified clay laid in concrete

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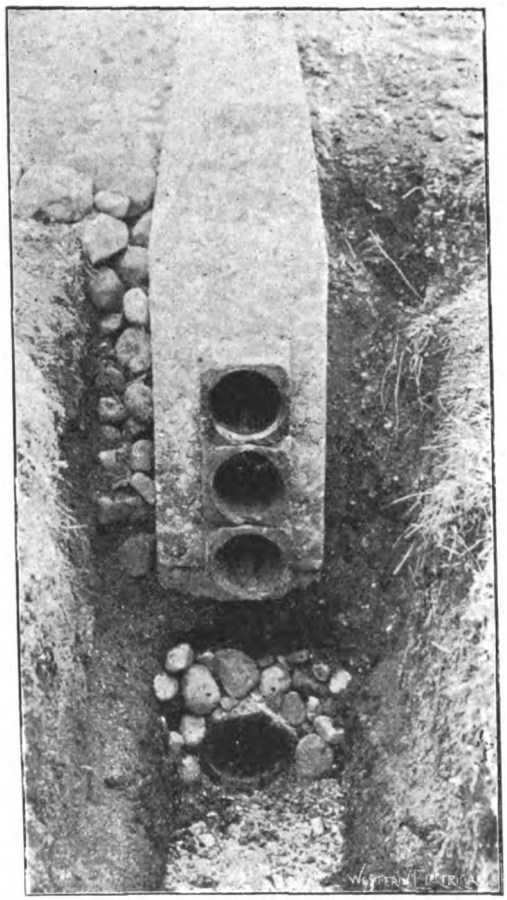
made in a manner competent to meet all working conditions. It is laid in the streets, and is furnished with as many compartments as may be necessary. The next figures ——, known as the Sampson conduit, are composed of vitrified clay tubing, preferably the above form, made by the H. B. Camp Company, of Aultman, Ohio, laid in concrete, molded in the form of sidewalk curbing, with man holes at street intersections, and hand holes at shorter intervals. Its advantage over the above form is that it does not require street space, and can be repaired or constructed without interfering with either sidewalk or street traffic. Its disadvantage is that in order to use it the old stone



curbing has to be removed. It is the best possible form of branch subway for new territory unpaved, as the curbing with tubing can be laid for future use at the same cost as the stone curbing.

There are many details of arrangement of this whole matter that have not been mentioned in this article. They are purely details, however, capable of adjustment on correct lines in conformity with this general plan. The greatest difficulty that the people of St. Louis have before them, is the harmonizing of the various wire-using interests. It is the settled principle of the interested companies not to combine with any other, and they will insist upon separate subways as long as there is the least likelihood of their demand being complied with. They will also insist upon the exception of certain wires from the exactions of any general subway ordinance, and if the city agrees to leave any wires above ground the whole force of the reform will be lost. In Chicago, certain wires are allowed to be run overhead on poles or buildings, and the great advantages of the subway system as a whole, are much discounted.

J. Allan Hornsby.

A WAIL FROM RUMFORD FALLS.

The commutator to the electric light machine gave out Saturday night and left us in darkness without a lamp trimmed. They have not got the lights to running yet.—Rumford Falls *Times*.

ROENTGEN RAYS "ANODIC" NOT "CATHODIC."

Since the first publications concerning Rontgen's discovery of the rays emanating from a Crookes tube, it seems to have been assumed by most investigators that said rays have some relation to the radiant matter of Crookes, which is a phenomenon of the cathodic terminal.

Others, again, have considered that the rays discovered by Rontgen were produced at the glass surface or during transmission through the glass, and as a consequence of the impingement of the cathode rays upon the glass, causing its fluorescence. Prof. J. J. Thomson is reported to have exposed photographic plates to the cathode rays or radiant matter within the tube without having produced any effect which could be brought out by development.

Very recently Prof. H. A. Rowland has pointed out the fact that the Rontgen rays are emitted from the anode, and not from the cathode, and this view coming from so high an authority is in itself an indication of its probable truth. The writer, personally, had been led to suspect that the rays were anodic, not cathodic; for it was found that the rays, when traced to their source within the tube, by methods which have been published by him, came from that terminal which, during the passage of the spark discharges, could not have been the cathode. Using a Wimshurst machine, it was easy to determine the polarities. Furthermore, the best effect on the photographic plates were produced opposite that portion of the glass which became strongly fluorescent. This fluorescence, however, could not have been produced from the cathode, as the rays normal to the cathode surface would not have impinged there.

By constructing a dark tube with a screen of barium platinocyanide the writer was able to submit to examination the various forms of Crookes tubes in his possession. Some of these, though fluorescing strongly by the cathode rays, gave at no position, with respect to the screen tube, any indications of the emission of Rontgen rays, while some gave feeble indications near the anode, and in exceptional instances a strong effect was noted, not from those parts where the cathode rays made the glass fluorescent, but from other parts opposite the anode.

The crucial test was made by placing a small patch of opaque metal upon the side of a tube opposite the anode. It was found that when the anode, the patch and the fluorescent screen were in line, no fluorescence was obtained, although the screen was fully exposed, as it were, to the cathode.

It may be mentioned here that the fluorescent screen tube forms a most valuable means for rapidly exploring the field of Crookes tube, and so determining whether it can be used as a source of Rontgen rays or not. It also enables one to determine the best direction in which the rays are emitted, and is much quicker than the sensitive plate for such observations.

In one of the tubes examined the effects appeared to indicate that the Rontgen or anode rays are deflected or turned aside sharply when they arrive near the cathode terminal, which in this case was a bent sheet of aluminum. This effect is worthy of further investigation.

The writer also personally exhausted a Crooke's tube by a Sprengel pump, watching with the flourescent screen tube for the indications of Rontgen rays. It was found that when that first degree of exhaustion was reached which gave an excellent exhibition of radiant matter from the cathode, and even clear cut shadows of objects by such rays as evidenced by the brilliant fluorescence of the glass where the rays impinged, there still was no indication of Rontgen rays, even when the fluorescent screen in its dark tube was not more than a quarter of an inch from the strongly fluorescing glass wall. As, however, the exhaustion improved, the indications of Rontgen rays began to be manifest, and at last they became quite pronounced. These rays seemed to originate at the anode, and although they may possibly be deflected in the vicinity of the cathode, they otherwise proceed in straight lines from the anode and through the glass, causing flourescence of the latter in much the same way to all appearances as the cathode rays, except that while the

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cathode ray fluorescence is fairly stable or stationary, the anode ray fluorescence flits about or changes its direction with every discharge, scarcely, if ever, repeating the same pattern of fluorescent patches on the walls of the tube or bulb.

The following summary of effects is apparently in accord with the facts:

First. Cathode rays are produced at lower exhaustions than give rise to anode rays that reach the glass.

Second. Anode rays are best produced at the very highest exhaustions short of insulation.

Third. Anode rays pass out through the glass of the Crookes tube: cathode rays (radiant matter) apparently do not.

Fourth. Both anode and cathode rays cause fluorescence of the glass and possibly of many other snbstances.

It is not known whether anode rays cause fluorescence of any substances that are not so affected by cathode rays, and vice versa.

Fifth. Anode rays are erratic in distribution from the anode surface. Cathode rays are of nearly uniform distribution, and leave the cathode surfaces at right angles.

Sixth. Anode rays are not capable of being deflected by a magnet; at least not after they have passed the glass. Cathode rays appear to be so deflected within the tube and after they have traversed an aluminum window. (Lenard.)

Seventh. Diminishing the size of the anode concentrates and focalizes the rays emanating therefrom. Shaping the cathode into a concave cup gives rise to a focus of cathode rays by virtue of their direction being normal to the cathode surface.

The question suggests itself: Can anode rays reach and pass through a thin aluminum sheet, which is at the same moment the cathode for the discharge? And, on the other hand: Can cathode rays traverse the anode if of thin aluminum sheet? It is probable that opacity of the opposite terminal would be noted in these cases, and possibly, deflection of the rays in each case near the terminal of opposite polarity to that emitting the rays.

The significance of Rontgen's discovery is greatly enhanced, and the scientific interest therein multiplied when it is recognized that there may be an entirely unsuspected radiation, not from the cathode but from the anode; that both electrodes may emit radiations characteristic of the electric states of the terminals, and that such radiations are widely different from each other and from other known radiations. If the anode rays are longitudinal waves in the ether, what are the cathode rays? If the cathode rays are longitudinal, what are those of the anode? Is it possible that neither of them are longitudinal vibrations of the ether, and that one must now look for an explanation of the two radiations which shall be alike, and yet not alike?

In these radiations there may be again a manifestation of differences between positive and negative electrical states, which differences seem to be in some way impressed on the radiations set up in the neighborhood of the poles. There undoubtedly is a great field for research opened by the discovery of Rontgen, and it is fortunate for science that the Crookes tube he experimented with possessed a high enough vacuum to cause it to give anodic as well as cathodic rays. ELIHU THOMSON.

AMERICAN INSTITUTE MEETING.

At the monthly meeting of council held March 25th, the returns of nominations were canvassed, and the following council nominees were selected: President, Louis Duncan, Baltimore. Vice-presidents, Chas. P. Steinmetz, Schenectady, N. Y.; Harris J. Ryan, Ithaca, N. Y., and W. M. Stine, Chicago. Managers, J. W. Lieb, Jr., New York City; F. A. Pickernell, New York City; Wm. L. Puffer, Boston, and L. B. Stillwell, Pittsburg. Treasurer, George A. Hamilton, New York City. Secretary, Ralph W. Pope, New York City.

The terms of the following officers do not expire this year: Vice-president, Angus S. Hibbard, Chicago; Dr. M. I. Pupin, New York City, and W. F. C. Hasson, San Francisco. Managers, A. B. Kennelly Philadelphia; C, S. Bradley, Baltimore; W. D. Weaver, New York City; W. B. Vansize, New York City; Chas. F. Scott, Pittsburg; Carl Hering, Philadelphia; Cary T. Hutchinson, New York City, and B. J. Arnold, Chicago.

The rules have been amended by the council under advice of the committee on incorporation, in order to conform with the laws of the State of New York. The rules will hereafter be known as the "constitution," and under its provision the secretary is now elected by the institute at large, instead of the council. The system of cumulative voting is abolished. Copies of the revised constitution will be mailed to the membership, with the ballots, on or before April 15.

The following Associate Members were elected: Philander Betts, 3d. U. S. Navy Yard, Washington, D. C.; Chas. Frederick Burgess, University of Wisconsin, Madison; A. Wright Chapman, Brooklyn, N. Y.; Wm. Edgar Firth, Germantown, Pa.; Frank R. M. E. Ford, New York City; Lucius T. Gibbs, Milwaukee, Wis.; Ch. Gorrissen, Baltimore, Md.; Elwin Clinton Green, Indianapolis, Ind.; Arthur Hamerschlag, New York City; Wm. S. Hulse, Baltimore, Md.; Arthur De La M. Lozier, M. E., New York City; Frederick Mackintosh, Schenectady, N. Y.; Jas. W. Manson, Jersey City, N. J.; Wm. J. Phelps, Chicago, Ill.; H. Hobart Porter, Jr., Lawrence, L. I.; Taylor William Ross, Key West, Fla.; Howard R. Sargent, Schenectady, N. Y.; W. M. Stewart, Jersey City, N. J.; Howard F. Thurber, Brooklyn, N. Y.; F. J. Dommerque, Chicago, Ill.; Harry E. Heath, Windsor, Conn.; M. T. O'Dea, Notre Dame, Ind.; Francis B. Badt, Chicago, Ill.; Willard E. Boileau, Columbus, Ga.; Elmer E. Boyer, Lynn, Mass.; James Mitchell, Rio de Janeiro, Brazil; Maurice Coster, Chicago, Ill.; John E. Lloyd, Philadelphia, Pa.; Wm. B. Potter, Schenectady, N. Y.

At the meeting of the institute in the evening a paper was presented by Prof. W. L. Puffer, of Boston, on "A New Method of Studying the Light of Alternating Arcs." Sixty members and visitors were present. After the reading of the paper at 12 West Thirty-first street, the meeting adjourned to Columbia University, where the experiments referred to were very effectively shown on a screen.

HOCHSPANNUNGSAKKUMULATORENBATTERIE.

The above is another little German gem which we notice in a contemporary. To solve it, it must be taken in installments; the real beginning is near the end; and the real end is the beginning; but this rule is not followed strictly, for if it were, it might be more convenient to read it by means of a mirror. Begin near the end, then start again near the middle, and continue this oscillating process until all the letters and syllables have been interpreted, being careful to get the right combination. The interesting part of the solution is to find the correct separation between the individual words, which are not separated by hyphens, presumably to save trouble (in writing, not in reading). For instance, this word has nothing to do with the following words, although they form parts of it: Ochs (German for ox), span, pan, sak, oren, (German for ears), renn (running), bat, batter or Erie, although these words taken together might suggest an interesting little story. The correct solution is as follows; A battery of accumulators whose voltage is high.—*Electrical World* (N. Y.)

REFINING FATS BY ELECTRICITY.

It has recently been claimed that oils and fats may not only be bleached, but sweetened and purified generally by treating them with an electric current. The system upon which this is effected is as follows: There is a tank divided into two parts by means of a porous partition; in one of the compartments thus formed is placed a solution of common salt, and immersed in this solution is a carbon electrode. A continous electric current is then generated by means of a dynamo, the oil and salt solution being agitated by mechanical means at the same time.

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The Roentgen Ray.

Many inquiries have been made concerning the actual present possibilities of the nameless ray in the fields of medicine and surgery. The highly colored pictures of what Mr. Edison has done and is doing, have served only to increase the expectations and anticipations of those who have followed the progress of the new science, and the vague intimations that find their way occasionally out of Mr. Tesla's laboratory, lead to a further belief in the near approach of something marvelous in the direction of this newly discovered radiant energy.

Without doubt, Professor Roentgen's discovery is destined to bring us to a better understanding of many things, but above all it promises to aid the physician and surgeon in making his diagnosis which, by the way, is the great desideratum in the practise of the healing art. But even in this field, those who think they will be able to take Mr. Edison's fluoroscope and see red blood coursing through the arteries and blue blood in the veins and perhaps finer shades of color elsewhere, will be mistaken. This kind of photography—if it may be so called, is purely a question of lights and shades, black and white, or even shades of gray. Plainly put, the Roentgen rays are beams of a certain kind of light, (again borrowing a misnomer). They extend in a direct line from their source. They are capable of penetrating certain material substances, but not all substances to the same extent. Therefore when a substance or material is placed between them and a sensitive photographic plate, their rays are thrown on the plate. If the material is all of the same consistency, texture and character, there will be no lights and no shades on the plate. Now introduce into the material—we will call it a leather purse—some body like coin through which these rays pass with great difficulty, the plate will not get the benefit of the rays over all its parts alike, as some of the rays are stopped by the coin. Hence there will be dark spots on the plate corresponding to the shape of the opaque body.

In treating the human body under this ray, the same principle will obtain. Bone is a poorer conductor of these peculiar beams or rays, hence we have heavy shading outlining the bones they may meet in transit through the body or any part of it. So again, certain soft tissues will introduce greater resistance to the passage of these rays, than other soft tissues, so that we might be, and in fact are, able to outline some of the organs, such as the liver; spleen, heart, stomach, etc. Carried a little further, there is no reason why, in the same way, we might not locate sacs of pus by this same shading, and determine by inverse calculation the extent of accumulations of water in the pleural or heart sacs, or even water on the brain. Experience will determine just how any given abnormal condition will be manifest on the photographic plate and undoubtedly this is where Mr. Edison's fluoroscope will achieve its success, but to make it avail for purposes of diagnosis, the physician will have to cultivate certain senses, and acquire experience in handling the instrument, just as he must do with his stethescope, opthalmoscope, speculum or microscope.

On the whole it may be safely said that the sensational period of the X ray has passed, and that from now on its useful application will be due to the development and a better knowledge of properties we now know that it possesses. It may be causally suggested that while we of America have made more fuss and stir about the whole business, we have contributed little aside from Mr. Edison's work—to its development. We have done enough in other branches of electricity to let Europe have the credit for this latest achievement.

Telegraph Instruments are Gambling Devices.

The Hon. Bill Skakel, of Chicago, has brought suit for defamation of character, and damages to his reputation, against Mayor Swift, the chief of police, the president and several members of the Civic Federation, in sums aggregating $500,000. There are twenty-seven suits, and the Hon. Bill says he would have made it a hundred, but the day was too short for the clerk to enter them all. The balance are promised soon.

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This sensational event would hardly interest the electrical people, but for the fact that electricity is brought in in a most depicable manner. About a week ago the Hon. Bill's "place" was raided by the police at the instance of the Civic Federation, on the charge of being a gambling place. The complainant, one Candy, a detective in the service of the Federation made affidavit, in order to obtain his warrant, that the premises, 73 Jackson street, was a place resorted to for unlawful gaming, and that there were concealed there "gaming apparatus and implements, used, kept and provided to be used in unlawful gaming, to-wit: telegraph instruments, blackboards, tape machines, tickers, transmitters and other devices." As these devices are also "used and kept to be used" for practically the same game on the board of trade, of which W. T. Baker is president, the Hon. Bill, backed by his attorneys, contends that the board is in the same boat with him. President Baker, of the board of trade, also president of the Civic Federation, claims to see a whole lot of difference between the business of Skakel and that of the board, and he has persuaded a good many professional reformers to see it his way. When the cases come up in court, two or three nice questions will also file forward for settlement. One is, whether sauce for the goose is not also sauce for the gander. Another is, can a place be raided on a warrant charging gambling, with the item that there are located in it, telegraph instruments, used to furnish information on which to gamble. Still another question will come up—namely, how it comes that reputable men and women allow this man Baker, to head a movement to suppress bucket shops, when the board of trade, over which he presides, causes more men to "go broke" and commit suicide, than Monte Carlo itself. Skakel ought to be suppressed, but it is the refinement of irony, to allow the job to be done at the instance of a man that nine-tenths of the people believe to be a greater violator of the gambling laws than the man he is allowed to prosecute and—persecute.

Incidentally, the officers of the telegraph companies, if they looked long and earnestly at the meat of this case, might see some things that, under nicely arranged circumstances, could rise to plague them. We would modestly suggest that they use every honorable means (in so honorable a case) to prevent a legal ruling that telegraph instruments are, under any conditions "gaming apparatus."

* * *

Reform in Chicago.

When things reach their present status in Chicago, one can smell reform in the air. The only trouble is that there is one kind of reform that smells so loud that it is disagreeable. Just such a smell emanates from the mess stirred up in the city council the past few days where Yerkes and the promoters of the Central Electric Railway are crying reform at each other, the same time both being engaged in robbing the people. As a climax to the scramble for possession of Jackson street, one of the finest boulevards of the city, so-called citizens spread a poster over the city on Sunday last calling attention to the last meeting of the old council for the following evening, at which it was rumored that the Central Electric bill was to be passed:

CITIZENS, ATTENTION!
COME TO THE CITY HALL TONIGHT.
THE RETIRING
BOODLE ALDERMANIC GANG
Contemplates eclipsing their infamous record by the passage of another boodle ordinance.
The presence of a few hundred reputable citizens may have a deterrent effect on the actions of these
PLUNDERING PUBLIC OFFICIALS.

Electrical Progress in China.

In another column, we publish a letter from our China correspondent, which will be of interest for two or three reasons: first, to show that America contemplates being somewhere in the neighborhood, when China takes a notion to come out of her trance: second, to show that while one of our companies did the business at the start, a European company, although an off-shoot of the first, has come in for a share. We have every reason to know that Brother Hamill is generous to a fault, but when it comes to business, we thought his motto was "all friendship ceases" At any rate, our letter, from an entirely reliable source, the writer being a young Jesuit missionary, indicates that China is about ready to join Japan in an endeavor to catch up with the rest of the world. Electric railways and lighting plants are to be the order in the Flowery Kingdom for the next few years, and—let's be in it.

* * *

Pratt and the X Ray.

We publish elsewhere a sensational article from the Chicago *Times-Herald* concerning the doings of Dr. H. P. Pratt and his associates, in the field of the X ray. There is absolutely nothing in the article or the pretentions of these men, and we print the article only as an evidence of how much rope a sensible newspaper will give to a notoriety seeker when he is chasing the same moonbeam they are following. This article contains more absurdities in less space than anything we have seen for a long time. The only thing sensible being the suggestion that as bacillicides, the X ray may be composed of boiling, freezing, and the like. We would like to add there are many surer germicides than the X ray. For instance a sure destroyer of the nameless germ that breeds an appetite for notoriety, is cold water or a wet blanket, or even the cold shoulder applied properly, and for a sufficient length of time.

* * *

High Salaries in Michigan.

The board of public works has hired Chas. Bush as superintendent of the electric lighting and water works plant at a salary of $500 a year, with John C. Brown as assistant engineer, salary $300 a year. Chas. Percival has also been engaged as wireman and collector at a salary of $300 a year. We do not think the board could have chosen better men for the positions at the salaries paid, and there is no doubt but what they will give satisfaction.—Stanton Michigan, *Clipper*, April 3.

And then some people think it strange that electric light stations don't make money. It should not seem strange at all with such princely salaries.

* * *

We have had very little to say in these pages about the Roentgen cathode, or X ray, but we have had a heap of fun reading what a good many people don't know about it. In other words, so many people know all about the whole subject, that there is little left to be said. We feel like the society reporter who came back from his first assignment at a ball without any copy, with the excuse that everybody was there, and they know what happened, so what's the use of writing about it.

* * *

President Cleveland has just signed the army appropriation bill with a clause to enable the Chief Signal office at Washington to add about $18,000 worth of apparatus to its equipment. Specifications are out and bids asked. Those wishing to bid, may apply to General A. M. Greely, Signal Officer, Washington, for full information. The purchases will be mostly telegraphic apparatus and electrical measuring instruments.

* * *

It is said that bad news travels fast, but evidently there must be some mistake about this. The French technical journals have just gotten possession of that old, old story of the family, who drank—feruginous waters until they became living magnets.

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Our contemporaries are just beginning to wake up to the fact that the Roentgen ray epoch has lighted up a good many dark places—and brought into view a good many "eminent scientists" who would otherwise have continued to blush unseen, and waste their sweetness on the desert air.

* * *

The recent purchase of large copper mines in Arizona by the Westinghouse Company, is another step in the direction of cheapening commercial electricity so that fields now closed to it for economical reasons will be opened. And so things go on adjusting themselves always to the benefit of those who sit up of nights to think it over.

* * *

The strike of the Electrical Workers in Chicago is another evidence of almost criminal mismanagement of the association's affairs. It would seem as though a few such lessons as these men have had would teach them to look before they leap.

* * *

Ohio now has an electrocution law, and without doubt the sensation center will be changed from New York to the Buckeye state.

* * *

When a man loses his collar button under the dresser, will the X ray be of any value as a substitute for profanity?

REFLECTED X RAYS.

Wonder if the X ray will ever be able to discover that mythical gentleman who is known to the world as the "nigger in the wood pile."—*St. Joseph, Mo. Herald.*

Pittsburg doctors think that by the use of the X ray they can cure a broken back, something which was hitherto practicably incurable. This probably explains why some of our leading national politicians are so careless about letting their financial policies lean two ways at once.—*Saginaw, Mich. Globe.*

A French scientist says he has discovered a method of applying the X rays to bombs so as to disclose their contents. It would be more to the purpose to go ahead with brain radiography and keep under inspection the man who is thinking bombs.—*Racine, Wis. Times.*

You can't fool Mrs. Lease. She had heard of the X ray, and when the Kansas City constables looked through her valise she was prepared.—*St. Joseph, Mo. Herald.*

This X ray business has gone far enough. A New York physician says that by using the new ray he has "found the stereytococcus erysipelatosus proliferating in the interspaces of the connective tisue." Think of that!—*An Exchange:*

It is claimed that the X ray will preclude the necessity of vivisection. If so, it will put a stop to what has long seemed to most people a horrible barbarity practiced in the name of science.—*Malden, Mass. News.*

X RAYS ON A BALL PLAYER.

For the first time in its history the cathode rays were used on a ball player, revealing what was first thought to be a splinter, by a second negative shown to be a dislocated small bone, in the wrist of First Baseman Peter Cassiday, of the Louisville Baseball Club. Cassiday broke his wrist in the Western League last year, and it was thought the bones had been set and had again joined together. The practice games this year caused the wrist to become inflamed and sore. President Stuckey, who is also a physician, and Dr. Vance took an X ray photograph yesterday of Cassiday's wrist. A second negative to-day revealed the dislocation, and this afternoon the bones were reset.—*Philadelphia Times.*

X RAY WONDERS IN EUROPE.

European observers are obtaining interesting results with the X rays. Prof. Virchow's assistant at Berlin has shown the lungs of a frog in the act of breathing. They have reproduced at Vienna the veins and arteries in a woman's hand, into which a chemical preparation had been injected. Two Paris journalists have photographed the writing in a letter through the envelope enclosing it. At Aberdeen rubies and diamonds were enclosed in an aluminum box, when the plate showed the rubies and the box, but not the diamonds. The French experimenters seem to be coming to the conclusion that the pictures are due to chemical action on the substance with which the plates are sensitized, caused by the electricity transmitted in the rays, while many English observers think that the pictures are formed by the action of electricity on the plates, rather than by any property of light.

ROSEATE PREDICTIONS FROM RED CLOUD.

The recent discovery of the X rays is one of the greatest advancements in science the world has ever known. This remarkable discovery enables the human eye to look through a human body, or any other subject inpenetrable by the naked eye. It will enable the physician to examine the inside of a person's anatomy and observe what organs are affected. It will, in fact, help, in a thousand ways, towards the preservation of human life, and there is not a doubt but that the coming generation will live many years longer than the present one. It now seems that there is nothing impossible in science.—*Red Cloud, Neb. Times.*

X-TRAORDINA-RAY.

Xtatic thrills thy hand conveys,
Xciting glance fond love betrays,
Xquisite rapture! could I gaze
Xulting on thy heart's dear maze!
Xceeding joy the hope conveys,
Xpressed by eyes where lightning plays,
Xcelling in their dear blue blaze,
Xploded "light of other days,"
Xampled only by X-rays;
Xtend thy beams thro' love's dark ways;
Xplore its depths, Xplain its craze,
Xtort from lovers endless praise,
Xcept from those whom hope gainsays;
Xeunt all spells of magic phrase,
Xert thy charm X-rays! X-rays!

—*An Exchange.*

The announcement that the *Rontgen* rays are capable of reflection is calculated to throw at least a doubt on their discretion. If they had reflected on the probable disturbing consequences, would they have allowed themselves to be presented in the arena of modern science?—*Pioneer Press.*

This matter of X rays is becoming alarming to some people. The next thing the bill collectors will be snapping a little machine upon us and sizing up our pile to a mathematical calculation.—*Jackson, Miss., Sun.*

The X ray slot machine is the latest device in the city for catching the surplus nickels.—*Wheeling Register.*

PERFECTION IN RAILWAY TRAVEL.

On the principal lines of the Chicago, Milwaukee & St. Paul Railway passenger trains are electric lighted, steam heated and protected by block signals. With these modern appliances railway traveling at high speed has reached a degree of safety heretofore unknown and not attainable on roads where they are not in use.

Subscription price to THE ELECTRICAL JOURNAL is $2.00 a year. Everybody should receive it.

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RECENT NEW YORK ACADEMY RECEPTION.

Interesting Exhibitions and Demonstrations were Marked Features of the Meeting—Some of the Subjects Discussed.

The receptions of the New York Academy of Sciences have already become notable occasions as exhibitions of scientific objects and apparatus, and they also constitute the most important annual gathering of scientists in New York; though they have only been held for three years, beginning under the presidency of Prof. John K. Rees, in 1894. The reunion was quite like a reception of the American Association for the advancement of science in its personnel. The exhibits covered a wide range, being classified in the departments of astronomy, physics, electricity, chemistry, photography, geology, mineralogy, physiography, botany, zoology, bacteriology, anatomy, paleontology, ethnology and archeology, and experimental psychology.

The New York Academy is fourth in point of age of American scientific societies, having been organized in 1817, under the presidency of Dr. Samuel L. Mitchell.

The formal features of the reception were a brief address from the president, Prof. John J. Stevenson, in which he reviewed the work and history of the Academy, and appealed to the citizens of New York to provide it a permanent home; and a lecture on the X rays by Prof. M. J. Pupin.

The exhibition of radiographs, as these pictures are now called, was doubtless the largest yet made in America, showing numerous views of human hands, arms and feet, and entire bodies of small animals. bringing out well the bony framework, as well as miscellaneous pictures of coins and other objects. The practical application of the new process in locating bullets imbedded in the flesh was well shown in several pictures, including one in the upper arm, and seventy-two shot in one hand. Edison's new fluorescent screen or "fluoroscope," made with crystals of calcium tungstate was shown and commended by Prof. Pupin as the best yet made. It consists of a small box, resembling in general shape an ordinary hand stereoscope, with a piece of paper or pasteboard covering its large end, with the calcium tungstate attached to it on the inside. This screen is held up to the eye, and the hand or other object to be examined is placed between it, and the vacuum tube charged with electricity. The bony skeleton of the hand is well seen. A sheet of aluminum an eighth inch or more in thickness and a plank of three or four inches were interposed without intercepting the view. The apparatus used to generate the electricity consisted of a large secondary coil, and the current was interrupted by a revolving motor, fitted with pieces of slate so arranged as to interrupt the circuit twice at each revolution. This was revolved at a speed of thirty revolutions per second, making sixty breaks of the circuit.

Other electrical apparatus shown was an apparatus for studying long electric waves, and curves, plotted from experimental data, illustrating the distribution of long electric waves along a conductor. An alternating electric current is propagated along a long conducting line, say a telephone wire, by a series of progressive waves. The exhibit represented an artificial conductor, 500 miles in length corresponding to a long distance telephone line of the same length, and the measurements obtained with it, represented the first experimental data that have ever been obtained in this field of electric research.

Another apparatus shown was for studying the magnetic lag in closed magnetic circuits, with diagrams plotted from experimental data, showing the results obtained. When iron is magnetized by a rapidly varying force, the magnetization does not keep in step with the force, but lags behind it. This lag is due to induced currents in the mass of the iron, and to internal viscosity; it is especially strong in closed magnetic circuits, and increases with the increase of the speed of the magnetizing force, but diminishes with the increase of temperature.

There was quite an array of photographs of lightning, described as follows:

1. First photograph of lightning ever taken, to prove that the discharge is wavy, not zigzag, as usually represented by artists. This was taken at Philadelphia, September 2, 1882.
2. Photograph clearly demonstrating the truth of the "wavy line" theory of lightning.
3. Artificial lightning, (Holtz machine discharged).
4. Divided discharge (forked lighting).
5. Branched lightning, explaining "tree marks" often found upon the bodies of persons struck by lightning.
6. Artificial "branched discharge," (the spark from a Holtz machine flashed directly across the face of the photographic plate no lense being employed.
7. Parallel discharges, stratification due to movement of conducting path by the wind.
8. Holtz machine "brush" discharge (photographic plate being placed horizontally between the electrodes), showing electrics "line of force."
9. Holtz machine spark, (plate being placed vertically between the electrodes showing electric "lines of force."
10. Meandering discharge. Illustrating the service of trees during a thunder storm—to dissipate, neutralize or conduct the discharge.
11. "Beaded" or "rosary" lightning. Supposed to be the track of a rotating ball of fire moving through space. A "thunderbolt."
12. "Beaded" or "rosary" lightning.
13. Two parallel discharges branching from a main stem.
14. Radial lightning. The discharge having the appearance of heat-cracked glass.
15. Collision of two discharges in mid-air, and the production of "thunderbolts."
16. "Ribbon lightning." (An oscillating discharge moved by the wind), caught on the prairie of North Dakota at midnight from the rear platform of an express train.

The physics exhibition included apparatus for voice analysis, and another for photographing the vocal cords in action; improved polariscope; double pentane lamp, the standard of illumination adopted in London; a two mirror heliostat; a tintometer, etc.

The stuffed skin of elephant Tip was a conspicuous object, and, beside it was arranged a phonograph which repeated song and dance of Vancouver Island Indians. A series of pictures gave what zoologists consider a very accurate reproduction of fossil mammals, such as the wintahtherium, tilanotherium protohippus, patriofelis, and other mammals with like cheerful and spirited cognomens. The department of anthropology was well represented, Prof. Putnam having come on from Harvard with an album of photographs of recent explorations of ancient ruins in Copan, Honduras; besides exhibits by others, showing specimens from Peru, Utah, Kentucky and elsewhere. Dr. Boas showed diagram illustrating the difference in the rate of growth of first born and later born children, showing that the first born have the best physical development, being taller and heavier than the later ones. George F. Kunz showed phosphorescence of the diamond. Spectra of the new elements argon and helium were shown, these gases being illuminated by electric spark and viewed through a spectroscope. A fine collection of photographs of star clusters and spectra of stars and planets were shown, including the trail of a meter which fell at Arequipa, Peru, September 6, 1895.

WM. H. HALE,
Late Pres. Am. Soc. Adv. Sc.

AMERICAN INSTITUTE MEETING.

The 105th meeting of the Institute will be held at 12 West Thirty-first street, New York City, on Wednesday, April 22d, at 8 P. M. A paper will be read by Mr. D. McFarlane Moore, of Newark, N. J., on "Recent Developments in Vacuum Tube Lighting," accompanied by experiments. The hall will also be lighted by these tubes.

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*THE SOURCE OF RONTGEN RAYS.

In an effort to locate the source of the X ray in the Crookes tube, the following experiment was made: Immediately beneath the bulb was placed a screen of lead, thick enough to be nearly opaque to X rays, with a circular opening one inch in diameter immediately under the bombarded spot of the bulb; 2½ inches below this diaphragm was placed a second screen with two openings of one-half inch diameter, located so far apart that any ray passing directly from the cathode plate through the first aperature would be intercepted by the second screen. Below the second screen was placed a photographic plate. The arrangement is represented in Fig. 1.

A short exposure and development of the plate brought out two densely black eliptical spots on the plate.

Referring to Fig. 1, if the X ray had proceeded from the cathode alone, in straight lines therefrom, no image would have been produced on the plate. The ray must have proceeded from some point in the tube far below the cathode to have reached the plate at all. The dimensions of the apparatus and of the spots on the plate were accurately measured, and were plotted out to scale in the way frequently used in optics. Lines 1 and 2, carried from the edges of the black spots past the edges of the screen, located the source of illumination at the wall of the bulb. Moreover, the illuminated spots on the plate showed strongly illuminated central disks surrounded by less sharply illuminated parts, such as might be expected to be produced by a source of radiation of considerable area acting through such a system of screens.

This experiment seemed to demonstrate that the ray did not proceed from the cathode alone, unless it was diffused in all directions from the wall of the tube at the point of bombardment. It, of course, did not differentiate between rays actually proceeding from the glass and rays which might proceed from matter in the same line within the bulb.

In the same experiment a pin-hole image of the bombarded spot of the bulb was obtained through a very small hole in the second screen.

Immediately following this experiment, acting upon the hint obtained in it, a number of pin-hole images were taken of differ- bulbs, the upper screen being absent. In a pin-hole photograph any source of X rays within the bulb, or on any portion of the wall of the bulb, would necessarily produce its image on the photographic plate below. In every case, however, the image on the plate was solely that of the fluorescent portions of the bombarded spot. The image corresponded in size, form and position with the utmost exactness to that which would be expected from the optical construction, on toe assumption that the source ef illumination was at the inner wall of the bulb. It was larger than the actual spot in the bulb when the distance from the wall of the bulb to the screen was less than that from the screen to the photographic plate, and smaller under the reverse condition

No image was obtained in any case of any spot or object within the bulb, other than the bombarded spot opposite the plate, serving as cathode. The image did not even include the diffusely fluorescent yellowish streaks radiating from the bombarded spot, or flickering about the walls of the bulb. Of course, with a current which converted the two electrodes alternately into cathode and anode, two spots of bombardment would be obtained.

It will be remembered that Prof. Rontgen, in his announcement of the discovery of the X-ray and its attendant phenomena, mentioned that when the stream of radiant matter is deflected by means of a magnet, the X ray proceeds from the new spot of bombardment. This proposition of Professor Rontgen has been abundantly confirmed by means of the pin-hole photographs. Beneath the bulb, the image of whose bombardment spot is represented in Fig. 5, was placed a diaphragm with a one-inch aperture having a pair of lead cross wires extending over the aperture and crossing at its center. The point of crossing of these wires was located immediately under the center of the series of concentric rings which constitute the source of X ray illumination in that bulb. Beneath the diaphragm carrying the cross wires was placed the usual diaphragm with a pin-hole aperture, and below that the photographic plate. When all was in readiness the stream of radiant matter, and consequently the spot of bombardment in the bulb, was deflected by means of a powerful electro-magnet, so that the second bright ring crossed the center of the cross wires. After a long exposure the plate was developed; the image showed the shadow of the cross wires and the rings which constituted the source of X rays lying eccentrically upon them, the most strongly illuminated band—that which appeared blackest on the plate—crossing the center of the cross wires. The source of X rays had been displaced to a different part of the bulb by the electro-magnet, namely, to the new spot of bombardment. The image is shown in Fig 5.

A similar experiment was made to determine whether the ray itself could be deflected. The magnet was placed to act upon the pencil of Xrays near the photographic plate, at such a distance that the action of the magnet did not produce any appreciable displacement of the stream of radiant matter, but that it

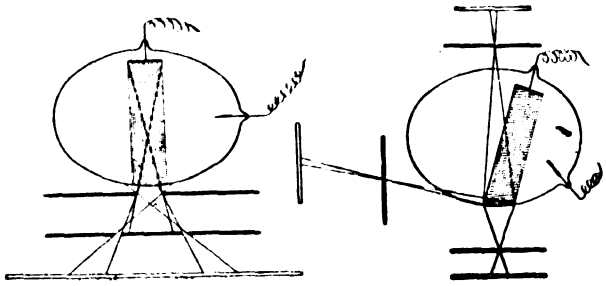

Fig. 1. Fig. 5.

would tend to produce a considerable displacement of the image upon the plate if the ray should be susceptible to its action. The plate was exposed with the magnet unexcited for 20 minutes, and then subsequently with the magnet excited for 25 minutes. If the image had been displaced by the magnet, two like images in different positions should be found upon the plate. As a matter of fact, but one was found, and that in position to indicate that the magnet was of no effect in displacing the pencil of rays outside the bulb.

The evidence of single pin-hole images of the different bulbs would seem to furnish sufficient grounds for the assertion that the Xray proceeded only from the bombarded spot at the inner wall of the tube opposite the cathode. A further experiment was made, however, which is conclusive on this point. Three pin-hole images were taken simultaneously of the same bulb. One plate and diaphragm were arranged to view the bombarded spot from immediately below. Another plate and diaphragm were placed at the side of the bulb. A third plate and diaphram were placed above the bulb, in position to look down directly upon the bombarded spot. A special bulb was made having its cathode placed in a somewhat oblique position, so that the bombarded surface might be visible from a point in a line perpendicular to it outside the bulb, without obstruction by the cathode.

When these plates were developed after a long exposure, the lower plate was found to contain the usual image of the bombarded spot at the bottom of the bulb. The plate at the side contained an inverted side elevation of the same spot. The upper plate also contained an image of the bombarded spot at the bottom of the bulb. On none of the plates was there any other image whatever, although each plate was exposed to the whole bulb. The small spot at the bottom of the bulb at the point of bombardment, on the inner wall of the glass, was the only point about the bulb from which any Xrays proceeded.

The images also tended to show that the source of the ray was at the inner wall of the bulb. If it had been at the outer surface there would have been no glass in the path of rays to the lower plate, and two thicknesses of glass in the path of those to the upper plate; hence the image on the former plate would have

*By C. E. Scribner and F. R. McBerty.

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been much stronger than that on the latter. If the source were at the inner wall equal thicknesses of glass would be in the paths of rays to the two plates. The images were of such depth of shading as to show that the plates had been equally illuminated, allowing for the difference in distances between the spot and the plates.

No more definite experiment than this seems possible.

These pin-hole photographs were made at different times between February 20th and March 15th, the first described experiment having been made at the earlier date, the last described demonstration about the latter date; the experiments were reported at a meeting of the Western branch of the American Institute of Electrical Engineers, on March 25th.

From all knowledge which we have been able to gain of the numerous experiments with X rays, we believe these experiments were the first to locate the source of the X ray; as respects at least the large number of tubes which we have used, they located the source accurately and conclusively. So far as we can learn also, no other pin-hole images of bulbs have been taken, excepting, perhaps, the one which Professor Rontgen thought he had obtained. This mode of photographing promsies excellent results in investigations as to the relation of the X rays to the cathode discharge.

BOOK REVIEW.

"The History of Oratory from the Age of Pericles to the Present Time," by Lorenzo Sears, L. H. D., Professor in Brown University. Cloth, 440 pages, $1.50, Chicago: S. C. Griggs & Co., 1896.

The history of oratory has been written at great length by many authors, but so compendious and comprehensive a history as that of Professor Sears has never come before the attention of the reviewer. The author traces for the past twenty-four centuries the history of the "Art of Arts," and shows its evolution from fundamental principles to have been derived from the successes and failures of orators through many centuries. He gives the reader in clear, concise language, a connected narrative of the beginning, growth, decadence and revival of the art, according to each typical orator his place in succession noting the rhetorical principles each exemplified and observing the trend of eloquence in the several periods into which he divides the subject. The sound scholarship and high attainments of the author and the masterly manner in which he has treated his subject, make the book of great value to all interested in oratory, from the clergyman, the lawyer and the politician, to the student.

A FISHY STORY.

Winter fishermen are beginning to use the electric light to attract fish. A tiny half-candle light is fixed in a bottle, which is closely corked and weighted, the lamp wires being connected with a suitable battery, the whole outfit costing less than $5. A small hole is cut through the ice, the lamp lowered into the water and the current turned on. The light attracts the fish from all directions, and as they are very hungry in winter they grab greedily any bait that is let down through the near-by holes. In several States laws have been passed forbidding fishing through the ice, as the wholesale onslaught was exterminating the fish.

WIRE BY THE TON.

A good idea may be gathered of the extent to which transmission of power by electricity is gaining ground in this country by the statement, that in the long distance plants, installed by the General Electric Company during 1895, over 1,200 miles of copper wire for transmission purposes alone were used, amounting, practically, to twelve hundred thousand pounds of copper.

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HARRY GOULD OSBURN.

The subject of this sketch, though one of the younger men in the electrical business is making his way to the front by rapid strides.

He was born in Michigan, thirty-three years ago, but found his way to Chicago as soon as he got old enough to discriminate. His first venture was in the soap business with the Kirks. He has since been connected with the Bain Electric Company and the Edison Company. He and his brother are now doing business under the firm name of Osburn Brothers. Their supply trade and agency business are growing rapidly, tributes to the energy, perseverance and pluck of the members of the firm. Harry Osburn is all wool and a yard wide, has a larger number of friends than almost anybody in business, and keeps them. He is married—and consequently safe from the evils and bug-a-boos of bachelor life.

ELECTRICITY IN TEXTILE INDUSTRIES.

The use of electricity in textile industries is rapidly widening, as its adoption is found to give to textile machinery the perfect regulation so essential to high-grade production. One of the most recent installations has been made in the mills of W. J. Dickey & Son, Baltimore, Md., by the General Electric Company. The electricity is generated by two 90 H. P. moderate speed generators, belted to a horizontal water wheel. The current is transmitted about 200 feet to the third story of a woolen mill where it will be used to operate motors and furnish light. In this third story thirty-six 60-inch woolen cards and four mules are to be placed, the cards being arranged in three rows, thirteen to a row with a line of shalfting to operate each row. The motors will be placed either on top of the roof beams or be suspended from the same beams by iron slings and will be connected to the line shaft by a belt. Two of these line shafts will be operated by two 25 H. P. slow speed motors. For the operation of the mules a 20 H. P. moderate speed motor will be connected to the shafting.

ELECTRIC LIGHT HEALTHY.

Electric lighting has made numerous contributions to sanitation. Dr. Saunders, medical officer of the London Board of Health, says that it has done much toward making the employes of commercial and manufacturing establishments healthier. "Faces that were pale and wan from work in gas-lighted basements, stores and shops are much improved since the introduction of electricity. The heat from the gas jets and poor ventilation are responsible for much sickness. It is also shown that in the same city the electric light has lessened crime.

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ELECTRO-THERAPEUTIC DEPARTMENT.

ROENTGEN RAY IN SURGERY.*

Its Influence in Diagnosis of Diseases Affecting Bony Parts—Dislocations and Fractures also Diagnosed.

ITS REVOLUTIONIZING EFFECTS IN PRACTICE.

I will consider Rontgen's ray only from a surgeon's point of view. When Professor Rontgen announced he had secured pictures of the bones when surrounded with natural and living tissues, he aroused the interest of the entire world, particularly the medical world.

It is difficult for anyone not a surgeon to appreciate the importance of securing outlines of deeply imbedded bones or foreign bodies. In the vicinity of joints fractures can only, with considerable difficulty and painstaking measurements, be discovered or differentiated from dislocations, and where both exist it is impossible at times to locate both—one or the other may be overlooked. Take, for instance, the thigh bone near its articulation with the hip bone. This joint is covered with large and powerful muscles and thick layers of tissue, so that it is difficult to outline the bones. Fractures and dislocations in this vicinity are diagnosed and differentiated largely by symptoms, such as the position of the leg and foot, the difference in length of the leg from its fellow. These and other means are those ordinarily employed by the surgeon. Given a fracture two or three inches from the head of the thighbone, who can tell whether the upper short fragment of bone is broken into one or several pieces. In childhood, injuries to the epiphyseal heads of bones frequently occur, and the exact nature of the injury is difficult to diagnose. Again, one of the most frequent of surgical diseases is tuberculosis affecting bones. This disease, which is more popularly known as consumption, frequently is incapable of detection until gross lesions or changes present themselves. Some idea of the prevalance of tuberculosis may be had when it is known that one person out of every seven dies from its ravages. Next to the lungs the bones are the tissues most frequently invaded by this disease. It is also true that general constitutional symptoms form no certain index of the presence of this disease in the bones. Exploratory operations are generally needed to form a diagnosis.

What is true of tuberculosis is also true of other malignant diseases, such as sarcoma or cancer. If their location happens to be in the medullary cavities of bones, no diagnosis can be made positively without exploratory operations. Abnormal growths on bones near joints are sometimes located by ordinary diagnostic means with great difficulty. Foreign bodies are difficult of detection when deeply imbedded in tissues, from their small size or from being enclosed in a dense structure. In the ducts leading from the large organs of the body are frequently found calcareous formations which can only be imperfectly determined by subjective symptoms.

All of these conditions have been definitely disclosed by means of the Rontgen pictures, and, with the exception of two, have been shown by pictures taken by Mr. C. E. Scribner and myself. We have shown tuberculosis in the wrist-joint of a child, the location of a sarcoma commencing in the marrow cavity of the thigh-bone of and an adult, fractures and exostoses of the bones of the leg, arm and hand, dislocation of joints, and have removed foreign bodies after their location, by means of the X ray, in the living subject. I may be pardoned for referring in detail to the location of a shot in the hand, as the removal of this body was the first surgical operation performed in this country when the diagnosis had been made by a Rontgen picture.

In the case of the sarcoma of the femur, a diagnosis could be made by inference only. No swelling or other changes in the soft tissues surrounding the bone could be found, but a picture taken February 24th last showed clearly this malignant growth in the center of, and confined to the bone. This picture distinguished clearly the fat from the muscles. An operation made three days later showed the accuracy of the picture. So far as I am aware, this was the first case of a central bony tumor being diagnosed by means of the X ray. When it is known that patients afflicted with these central bony tumors are not infrequently treated for months for neuralgia or rheumatism, some idea of the value of this aid to diagnosis may be had, especially when it is remembered that every day the disease is unrecognized increases the chances of the transmission of the disease to other parts of the body, thereby endangering the life of the patient.

In one case a picture of a hand was taken which showed clearly the presence of a part of a fine cambric needle lying adjacent to the inner side of the long bone of the hand corresponding to the thumb. This part of a needle was not quite one-half inch in length, and several unsuccessful attempts had been made by surgeons to remove it With the picture as a guide, it was successively removed; and, as it had been in the hand over five years, occasioning a great deal of pain and the loss of use of the hand, its removal firmly fixed in the mind of this particular patient the value of the Rontgen ray.

However, it is not alone in diseases of the bones and the presence of foreign bodies in tissues that this agency will be of use. When it is possible to control the rays, securing greater or lesser intensity, as may be desired, it is not beyond the range of possibility that many diseases of the soft tissues may be recognized. For instance, in valvular diseases of the heart it may be possible to recognize some forms of lesion. Calcareous formations sometimes occur in the lungs or other organs, and these should be susceptible of definition. Some of the grosser inflammatory alterations in tissues may be recognizable. Renal and biliary calculi should be disclosed upon proper exposure to the ray.

The range of use of this ray, however, may be easily over-estimated. It should not be forgotten that many of our most serious difficulties have their origin in changes so minute as to escape an inspection of the tissues made with the naked eye, and it is only when properly prepared and brought in to the field of a microscope of great power that many changes in tissues, serious in their results, can be detected. For instance, take a paralysis affecting the muscles of the arm; that part of the spinal cord in which the nerves furnishing motive power to these muscles originate is the cervical part of the spinal cord, and should give a good picture; but how could we expect to obtain any assistance in the diagnosis from this picture when, if the spinal cord itself was laid before us, no examination made by the naked eye would disclose the slight inflammatory changes that produced the disastrous results causing the loss of use of the arm? It is, therefore, difficult to imagine that any improvement in the methods of taking these pictures would ever disclose the differences if so minute as to require the use of a microscope for their detection. No photographic print on paper gives an idea of the full value of this process. The negative is always more distinct than any print. The several improvements which have been described and shown to you this evening in the taking of these pictures will add greatly to their surgical value.

Many substances are shown by former experimenters in this field to have the property of fluorescence, or illumination, under the influence of this ray. Taking advantage of this, fluorescent screens have been prepared. I understand that to Professor Salvioni, of Perugia, Italy, is to be given the credit of first combining this screen with a tube, in one end of which was the

*By James Burry, M. D. 1. Read before the American Institute of Electrical Engineers, Chicago, March 25, 1896.

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screen and in the other a lens, thereby getting instantaneous and clear shadows.

I believe with the improvements already made, and that will be made, by electricians in the production and control of the X ray, surgery will find in the process a most valuable aid in diagnoses, and mankind will be correspondingly benefitted.

THE X RAY AS A GERMICIDE.

More Rot on the Subject Than Has Ever Yet Been Gathered Into the Same Space.

The Chicago Tines-Herald prints the following, which might be labeled important if true.

Epidemics will be impossible. Asiatic cholera is no more to be feared than earache. Diptheria and glanders and typhoid have at last met a power stronger than their own malignancy. The threats of deadly bacilli may bring less terror than the sigh of an evening breeze, and pneumonia and tuberculosis be more inconveniences than pests. This is the future of contagion, with the Rontgen ray in the regular practice and a companion of saw and scalpel and lint, according to two Chicago physicians.

Professor H. P. Pratt and Professor Hugh Wightman, the electro-therapeutist and the bacteriologist of Bennett Medical College, have practically proved this. They have put the germs of eight of the most deadly diseases through the test. A week has elapsed. They have been fed and nurtured with the greatest care. They have failed to propagate or spread, proving they are dead or have been stunned. Diptheria was slain outright. There is no doubt of the effect in this case. The same final and positive verdict in the others is reserved for a few days that the bacilli may have the best possible chance to revive and that every scientific requirement of the experiment may be fulfilled.

It is admitted by the two physicians, who have spent day and night in the laboratory, that they have been startled by the dissoveries. They have worked with the germs in test tubes. They maintain that success, secured under this disadvantage, predicts much more marvelous effects when the same attack shall be made upon these enemies located in the human body. The method will be tried at once. They will not be able to get patients with all the diseases which they claim to have conquered, but reason that success in one means success in all by varying the strength of the cure.

This is the group upon which they made the initial investigation:

1. Bacilli of cholera.
2. Bacilli of diphtheria.
3. Bacilli of influenza.
4. Bacilli of glanders.
5. Bacilli of pneumonia.
6. Bacilli of typhoid.
7. Bacilli of tuberculosis.
8. Bacilli of anthrax.

The various germs were grown in tubes in proper media. Magnetic lines of force from the Crookes tubes were passed through them. The application lasted for two hours.

Cholera was the easiest, and appears to have been wiped out entirely. Diphtheria has been treated very tenderly and favorably, but after eight days has failed to show the slightest signs of life. There has yet been no activity in the bacteria of the other classes, and, with certain modifications, the distinguished doctors are now ready to announce that the ray, properly applied, will destroy any form of infectious or contagious germ. This is endorsed by the college faculty, and the entire electrical equipment, the best in the west, will be turned over this week for future proof of the discovery.

Professor Pratt says the theory and reason is easy and very practical. The magnetic force from the X ray will pass directly into the affected tissues. Electrolysis will result. The chemical decomposition will liberate oxygen, which will unite with the free oxygen of the body and make ozone. Ozone will kill every bacteria the body may possess. The present state of the experiment proves outright murder in some instances and inability to work in others. The effect in either case will be eventually the same to the patient, the tissues in the latter instance gaining new strength and driving out the bacilli

Professor Wightman, the bacteriologist, would have been less amazed had all the tubes failed to show any killing power of the ray. There was a certain crudeness in the first apparatus. It was less satisfactory to operate through the tubes than by actual cases in the human body, the glass in some cases interfering with the force. While, as yet, there is no evidence of activity in any of the deadly collections of germs, he fears there may be left somewhere in the tubes a spark of life which shall spread itself over the entire mass. This has not appeared within eight days.

Dr. Pratt is convinced that this force from the Crookes tube is the single agency that is fatal to all forms of bacteria. Some are destroyed by cold and some by heat, but they have all remained quiet for a week under this destroyer. The disease-producing ones thrive best at a temperature of 100 degrees. The others multiply at a much lower temperature, some propagating best during the coldest weather. Boiling water will wipe out some members of the family, and freezing the others. Daylight is fatal to most of them, but it being impossible at present to project the sun into the human system, the great discovery of the German scientist makes an invaluable substitute in the electric ray. Drs. Pratt and Wightman are the first in the world to apply it.

CURRENT ACTION ON TOXINES.

Toxines Attenuated Experimentally by Means of the Alternating Current for Prophylactic Inoculation.

D'Arsonval and Charrin continued in the Biological Society of Paris, on February 7, their interesting contribution on the action of electricity on the bacterial toxines. The previous researches of these observers have been already abstracted in THE JOURNAL. In order to determine whether the pyocyanic and diphtheritic toxines when attenuated by electricity, could be used for vaccination against the living bacillus, they inoculated each of three guinea-pigs with three c. c. of pyocyanic toxine attenuated by the alternating current, and ten days later inoculated each animal with two c. c. of living culture of the bacillus pyocyaneus. At the same time two guinea-pigs unprotected by vaccination, were inoculated each two c. c. of the same culture. One of the latter died thirty-six and the other forty-eight hours after inoculation. The three protected animals, however, did not suffer at all from the inoculation which killed their unprotected comrades.

As a second experiment, four guinea-pigs were each inoculated with 2.5 c. c. of diphtheria toxine by the direct current, two of these animals were inoculated with two c. c. each of a living culture of the bacillus diphtheriticus five days later, and the other two eight days later. At the same time three unprotected guinea-pigs received the same injection. Two days thereafter, as all the animals appeared healthy, a further injection of two c. c. of the same culture was made in each of the seven animals. Forty-eight hours after the second inoculation, one of the unprotected guinea-pigs was found dead, and the next day another died. Two of the vaccinated animals also died. The remaining three, two of whom were protected, and one unprotected were ill. Thus out of the seven animals only three survived, two of whom had received protective inoculation. Complete minimumization was therefore not obtained

The diphtheritic toxine, it should be noted, was attenuated by the direct current which produced chemical changes in the products of electrolysis, while the pyocyanic toxine was attenu-

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ated by the alternating current which produced a very much weaker chemical action, but a great molecular change.

The results of these experiments recall the law, formulated by the authors in their first report that attenuation of toxines depends more on the quality than the quantity of the electrical current employed. Chemical action destroys more than it attenuates the toxine. Attenuation should consist in the production of molecular changes rather than in destruction. A form of electric energy should, therefore, be employed for this purpose, which is capable of producing violent molecular changes, unaccompanied by any chemical action whatever.

The apparatus employed was that which D'Arsonval employs in electro-therapy for the application of local high frequency currents. The solenoid at either extremity ends in a platinum wire, and these wires are placed in the tube containing the toxine. An alternating current of about 200,000 interruptions per second is then passed through the toxine, heating of which is avoided by plugging the tube in a refrigerant mixture.

The authors have thus electrified a very active diphtheria toxine in a quarter of an hour, and have injected 2.5 c. c of the toxine thus attenuated into three guinea-pigs, and the same quantity not attenuated into three others. The latter died in twenty, twenty-four and twenty-six hours, respectively; the former were not even made ill.

This experiment proves that high frequency currents completely destroy the toxicity of diphtheria toxine by simple molecular change, without any chemical action.

Whether toxine thus treated becomes a vaccine cannot yet be stated, but unquestionably this anti-toxic action of high frequency currents has a great clinical importance. These currents which have no action on sensibility or motility, as D'Arsonval has demonstrated, might be made sufficiently powerful to destroy or attenuate the toxine in the organism itself.

DISSECTION OF THE "BREEZE."

Bordier made a report to the French Academy of Sciences, December 9, 1895, which was abstracted in the Archives d'Electricite medicale of February 15, 1896. The experiments made were to determine first the influence of the sign of the pole, upon the surface acted upon by, and upon the intensity of the electric breeze, and second, the variations of the service acted upon with the changes of the angle of the cone forming the pole. From these experiments, the author draws the following conclusions:

1. The fasciculus formed by the electrified air is more divergent when its point is toward the positive, than when it is toward the negative pole.

2. The negative breeze has a greater intensity, other things being equal, than the positive breeze. By this means the sign of the pole of a static machine may be distinguished.

3. The surface acted upon by the breeze varies directly with the angle of the point of the pole, it becomes smaller as the angle of the point is more acute, and attains its greatest extent when the angle is about ninety degrees. The extremely fine points which have been employed in electrotherapy, may with advantage be replaced with points having an angle of at least ninety degrees.

TWELVE THOUSAND LIGHTNING ARRESTERS.

Although the season has scarcely opened, the demand for Wurts' Lightning arresters, that are being made by the Westinghouse Electric & Manufacturing Company, bids fair to be phenomenal. How popular this lightning arrester has become, and how well it has proved its efficiency may be gathered from the fact that during 1894 the Westinghouse Company sold nine thousand arresters, and in 1895 twelve thousand, while every indication for the present year promises to double the sales of last year.

The subscription price to the ELECTRICAL JOURNAL is $2.

THE AMERICAN BELL COMPANY'S REPORT.

The annual meeting of the American Bell Telephone Company was held in Boston, on March 31. The annual report for the year ending December 31 last, shows the following results, compared with those shown in the report for the year previous:

Gross earnings	$ 5,124 952	$ 4,848,244
Expenses	1,911,193	1,724,459
Net earnings	$ 3,213,759	$ 3,123,785
Regular dividends	2,502,453	2,400,000
Extra dividends	630,000	600,000
Total surplus	$ 2,151,011	$ 2,151,011
Earnings and expenses in detail earnings:		
Rentals	$ 2,125,359	$ 2,502,992
Dividends	2,523,149	1,937,657
Extra territorial	148,694	106 939
Telegraph	32,422	29,352
Real estate	76,175	69,675
Interest	215 230	196,455
Miscellaneous	3,831	5,172
Totals	$ 5,124,952	$ 4,848,244
Expenses;		
Operation	$ 495,611	$ 430.340
Legal Expenses	182,754	178,342
Real estate	37,452	35,798
Interest and taxes	245,536	356,478
Commission	296,284	459,958
Royalty	1,452	5,000
Concessions	649,508	231,713
Miscellaneous	2,592	26,827
Totals	$ 9,911,193	$ 1,724,459
Ledger balances December 31.		
Debtors.	1895.	1894.
Telephones	$ 1,285,946	$ 1,209,787
Real estates	1,045,926	959,926
Stocks	44,128,680	38,268,455
Merchandise and machinery	14,054	14,232
Bills and accounts receivable	3,463,213	4,355,554
Cash and deposits	1,337,892	760,776
Total	$51,268,715	$45 559,733
Creditors:		
Capital stock	$21,500,000	$20.0 0,000
Premium account	1,398.435	.....
Debentures	2,000,000	2,000,000
Bills and accounts payable	$1,120,616	‡1,107,949
Patent account profit and loss	12,7 3,309	10,228,571
Profit and loss	6,349,444	5,849,444
Reserve	4,035,399	4,222,756
Surplus	2,151,011	2,151,011
Total	$51,268,715	$45,559,733

*No portion of the earnings of the Metropoliton Telephone & Telegraph Company were divided.

‡Of this amount $900,000 is for the dividends payable Jan. 15, 1895, to stock of record Dec. 31, 1894.

§Of this amount $967,500 is for the dividends payable Jan. 15, 1896, to stock of record Dec. 31, 1895.

In his report President Hudson says that not only has the business increased with such great strides during the year, but the tendency to turn itself into the best class of service, metallic circuit, has continued without abatement, or rather has increased in rapidity. Jan. 1, 1896, finds the total number of metallic stations 94,747; being a gain during the year of 40,067 over the number with which the year began.

Within the last five years alone 130,000 miles of telephone wire have been placed underground. The Long Distance Company had invested up to Dec. 31, 1895, in line construction, franchises, equipment and supplies $11,435,055.02.

The company shows an increase in gross earnings in 1895 over 1894 of 31.1 per cent., the amount for 1895, gross, being $1,326,683.89.

The stockholders re-elected the old board of directors and voted to increase the capital stock from $21,500,000 to $23,650,000.

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DOLBEAR'S ADVANCED THEORY.*

Future Study of Medicine and Surgery Must Take Into Account an Electro-Magnetic Disposition and Arrangement of Molecules.

AN ELECTRO-MAGNETIC BASIS OF PHYSIOLOGY.

A living thing, whether plant or animal, is made up of protoplasm. If it be one of the so-called higher forms, it consists of a great number and variety of cells, all acting concertedly for maintaining the integrity of the whole as an organism. If it be one of the simpler ones, there may be few or only one cell, that one assuming various functions, for nutrition, reproduction, movement, and so on, and may be there is a substance which is without form or structure, except what surface tension and simple chemical admixtures may give to it, which possesses in some degree this quality which we call life or vitality. Some microscopists think they can descry in this living stuff, which is without differentiated parts, a fine net work, a mesh in which chemical reactions take place, and thus think they save the idea of mechanical structure as an essential condition for living matter.

A minute speck, only the ten-thousandth of an inch in diameter, can hardly show any organization if it has it, but its movements, growth, and multiplication may be seen. Such a speck must be made up of millions on millions of atoms of whatever sort may compose it. If we assume the average diameter of an atom to be the fifty-millionth of an inch, then a particle the ten-thousandth of an inch in diameter would contain five thousand contiguous ones in its diameter and the cube of that number, which is 125 billions, in its whole structure. Is there anyone who can think for an instant that the smallest living thing which can be seen can be the smallest living thing? If not, then how can the microscope ever be serviceable in settling the question of spontaneous germation? To ask the question in this way is to ask, supposing the doctrine were true, how could it be corroborated by observation. I do not recall that anyone has stated or given reasons for thinking there are *cell structures* smaller than those which the microscope will now reveal, though protoplasmic masses of all degrees of magnitude down to say the fifty-thousandth of an inch are noted and described more or less minutely. Huxley speaks of an amœba as a "blob of jelly," but it is a living thing. The step from cell structure to a blob of jelly is a step from form to substance, and makes it needful at once to reconsider the relation which life sustains to matter in general.

If life be the cause of organization rather than the result of organization, as John Hunter thought, then one is driven to molecular groupings, and the study of morphology, carried never so minutely, will discover only what life *does*, not what it *is*. The microscope adds to the number of known forms, not to their intelligibility.

Vital force as an agency, extra-material in its nature, was assumed as imposing upon organized matter the functions of life. After the discovery of the conservation of energy, the doctrine was shelved, for it was made evident that the energy for running the physiological machine was supplied by the food and air provided, and that no more work was got out of the mechanism than the mechanical equivalent of the material, if consumed in any other kind of an engine. Dr. Carpenter early applied the doctrine of the conservation of energy to physiological processes and correlated vital actions with chemical, thermal, and electrical actions. But chemical, thermal, and electrical actions are not only correlated, they are transformable into each other so that when, for instance, chemical actions result in heat; the chemical activity is annihilated, while heat is practically created; that is, one is transformed into the other and no longer exists. Applying this to vital actions, vitality or life would be but a form of energy transformable into others under proper conditions. Now the proper conditions for the transformation of one kind of energy into another is some kind of a mechanism. If heat energy is to do the work it must be provided with an engine. If it is to appear as electrical energy it must have a thermopile, and if electrical energy is to become mechanical energy it must have a motor, and so on. If, then, the analogy is to hold in vital phenomena, if chemical energy is to be transformed into vital energy, there must be some kind of a transformation, and if a cell in the physiological sense is not necessary then the mechanism must the molecules themselves. If, too, life be the cause of organization, then it must be behind all organization, and if it be behind organization, and conditions organization, then it would seem that one must look even beyond the molecule of any kind for the agency that organizes. Molecules are more than simply aggregates of atoms. There is organization, and a very definite one too, in the simplest of them, as all chemistry shows. Crystallization is a geometric organization, but the more complex the molecule the less stable it is; that is, the easier it is broken up into more stable compounds. Now, protoplasm is highly complex, probably more than a thousand atoms in its molecule. It is more proper to speak of it as a mixture of many slightly coherent molecules, water, oils, alkalies, and acids, within which chemical and physical actions are going on all the time, exchanges and transformations of energy. Butschli and others have shown how to make, in an artificial way, an emulsion which behaves like an amœba; putting out pseudopodia, gathering in and assimilating external material and moving about, all fundamental physiological phenomena.

So far the functions of the natural and the artificial are identical. Must one not say that such behavior in an artificial compound reduces those functions in living things to physical and chemical activities alone; thus narrowing the distinction between so called living and non-living matter to the single one of reproduction? Growth, movement, assimulation, and reproduction are the physiological functions of living matter and these can be carried on in structureless matter, unless one enlarges his definition of structure so as to include bubbles, emulsions, and surface tension arrangements, and here is where vital phenomena are now tracked. Is it not plain that matter which possesses in itself so great potencies as we already know has very different attributes from those commonly assumed when it is spoken of as "dead" and "inert"?

So long as forces were supposed to act upon matter compelling it to act thus and thus, there were as many forces invented as were thought needful for the theory. These were only looked after philosophically when they were on duty. When off duty no one thought or cared to know what became of caloric, electric and magnetic fluids and chemical affinity. Caloric was dismissed a long time ago. Nobody talks about the electric fluid now any more than he does magnetic fluid, and as for chemical affinity, it has been proved to be non-existent where the temperature is low. In his book on modern theories of electricity, Professor O. J. Lodge implies that the existence of electricity itself is becoming problematical: that electrical phenomena no more imply the existence of a something called electricity than do thermal phenomena imply the existence of caloric. The phenomena themselves may be explained by stresses and movements in the ether produced by the activity of the atoms of matter. As all kinds of atoms exhibit electrical and magnetic phenomena in some degree, depending upon their condition, environment, and combination, it appears needful to assume for atoms of all kinds of matter, electric qualities which are as inherent in them as is any of their other qualities, such as gravity, elasticity, and mass. Indeed, for the explanation of the simplest chemical reaction, it is now held that each atom possesses a definite electric charge, and all reactions in solutions represent transfers of electric energy and the separated parts are called *ions*, whether they be as solids, liquids, or

*By Professor A. E. Dolbear, Tuft's College, Mass.

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gasses. It is believed that no chemical action can possibly take place when the conditions do not allow electrical changes.

The meaning af all this to the physiologist lies here. Every physiological action whatever represents some sort of a chemical change—the contraction of a muscle, the maintenance of temperature, the secretions of all sorts and digestion in all stages. There is no reason for holding that a chemical reaction within the body is different from what it would be out of the body, and if out of the body all chemical reactions are electrical phenomena, they must be held to be the same within it.

More than forty years ago Faraday investigated the relations of the elements to magnetism and found that all of them were subject to it, varying in degree, and he concluded that all kinds of matter was magnetic in some degree, and since then it has been further learned that temperature disguises the effects in a marked manner. Thus the element oxygen appears as slightly magnetic at ordinary temperature, but it is strongly magnetic at the low temperature of 100° C.

Such a statement as that seems to imply that the magnetism of a body depends upon its temperature, whereas it is known that magnetism is a property of the atoms themselves and there is no evidence that it is variable. What we call magnetizing a piece of iron means only that its molecules are arranged in such a manner that the magnetic fields of all the atoms act conjointly with each other and thus give an external field—the atoms are no more magnetic than before.

At absolute zero magnetic quality would be at its maximum, but temperature gives rise to chemical activity and to molecular arrangements, which disguise the quality by overlapping fields, and chemical reactions rearrange the magnetic stresses and result in electric currents in short molecular circuits.

For these two reasons the two words electro and magnetic are combined to indicate that where there is a magnetic disturbance there electrical phenomena always appear.

Apply this to physiological phenomena, normal or abnormal, every organ is built of units called elements, of an electro-magnetic nature in their properties in the same sense as they are gravitative. Whether they be organized in one way or another will make no difference except in the degree of complexity, and every change brought about through them or by them is a change in electro-magnetic units with disturbances in magnetic fields, in electric changes, and transient currents. They are electrical before they are chemical. The mere fact that they take place in the body of an animal or of a man makes no difference, and we may, therefore, hold that the basis of physiological activity of every kind is electro-magnetic and that a complete knowledge and understanding of physiological functions will only be reached through the study of structures and products as related to electrical laws and phenomena.

Thus the body is an electro-magnetic machine and electro-magnetic conditions regulate all its functions.

These considerations gave validity and a rational basis to electro-therapeutic study and effort, and one may look forward confidently to the swift-coming time when all kinds of ailments will be intelligently met by electro-therapeutic practice.

THE UNDER RUNNING TROLLEY PATENTS.

Judge Townsend's decision, further sustaining the patents of the General Electric Company on the Under running trolley, has had the effect of bringing the question of these patents into the foreground, and many inquiries are being made as to their exact nature. For the benefit of the electrical public, we give the chief claims:

Claim 6. In an electric railway, the combination with a suitable track and a supply conductor suspended above the track, of a car provided with a swinging arm carrying a contact device in its outer extremity and means for imparting upward pressure to the outer portion of the arm and contact, to hold the latter in continuous working relation with the under side of the supply conductor, substantially as described.

Claim 7. In an electric railway the combination of a car, a conductor suspended above the line of travel of the car, a swinging arm supported on top of the car, a contact device carried by one extremity of the arm and held thereby in contact with the under side of the electric conductor, and a tension device at or near the other end of the swinging arm for maintaining said upward contact, substantially as described.

Claim 8. In an electric railway, the combination of a car, a conductor suspended above the line of travel of the car, an arm pivotally supported on top of the car and provided at its outer end with a contact engaging the under side of the suspended conductor, and a tension spring at or near the inner end of the arm for maintaining said upward pressure contact, substantially as described.

Claim 12. In an electric railway, the combination with a car, of a post extending upward therefrom and carrying a suitable bearing, an arm or lever carrying at its outer end a suitable contact-roller and pivotally supported in said bearing, and provided at its inner end with a tension spring for pressing the outer end of the lever carrying the contact wheel upward against a suitable suspended conductor, substantially as described.

Claim 16. An electric railway, the combination of a car, a conductor suspended above the line of travel of the car, an arm pivotally supported on top of the car and provided at its outer end with a grooved contact-wheel engaging the under side of the suspended conductor, and a tension spring for maintaining an upward pressure contact with the conductor, substantially as described.

LONG DISTANCE POWER TRANSMISSION.

The feasibility of power transmission by means of electricity over distances of limited extent had been clearly demonstrated in the long year of experience with the direct current, but transmission by means of the direct current speedily reached a limit beyond which, for economical reasons, it became inadvisable to go. Yet it was transmitted over very long distances. How best to effect this became the urgent question of the hour.

The direct current was, perforce, discarded, and the alternating current called into requisition. Attainment of an economical solution was by no means easy. Difficulty after difficulty arose, requiring countless experiments to elucidate; and alteration after alteration in machinery was made, involving the expenditure of vast sums. By successive and painful stages a solution was finally reached, and today the long-distance transmission of power by electricity is an established economic fact of a potentiality which seems limited in its comprehensiveness only by the exhaustion of the available natural forces of the earth.

Indeed, everything points to a corner in water powers, speculative enterprise keeping steady step with honest industrial initiative, and generally a little in advance. Waterfall and cataract have suddenly assumed a greater interest to their owners than that imparted by their merely scenic features. Hitherto unutilized water powers have become, in sanguine imagination, possible gold mines in future and the elimination of the domestic coal heap and relegation of the steam engine to the oblivion which awaits the discarded have become articles of faith with water power proprietors.

By far the greatest number of the long-distance transmission installations of the world are situated in the United States. The American seems endowed with the courage of temerity, and is willing to adopt a new thing with promise only, where other nationalities demand assurance or proof. A possibility has a special attraction for the American mind, and the risk of its realization is willingly run. It is this spirit that has covered the United States with electric lighting stations, spread a network of electric car lines over every city of any importance in its boundaries, and initiated the supercession of the steam locomotive itself from its main line railways.—*John McGhie in Cassier's Magazine for February.*

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CHARLES JOSEPH VAN DE POELE.

Born in Flanders, Belgium, April 27th, 1846. Died March 18th, 1892. Originated and Perfected Commercial Electric Traction. Built the First Overhead-Conductor Road at South Bend, Ind. Greatly Developed Electric Arc Lighting.

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The Electrical Journal.

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LIFE AND LABORS OF VAN DEPOELE.

LATE HONOR DONE TO A TRULY GREAT MAN

Biography of the Late Inventor and Electrician, Prepared by Mr. Frankland Jannus, Who Knew Him Intimately.

The Van Depoele patents on the one side, and the Tesla patents on the other, may be said to account for the recent business agreement between the General Electric and the Westinghouse Companies. In consequence the personal achievements of these two men to say nothing of their personality is of uncommon interest. Mr. Tesla is, to the good fortune of the world, still in the mid-day of his career, and has his future before him—so to speak. Mr. Van Depoele died in 1892, just has he had entered into that success and independence which he had earned by a life of toil and hardship against the most discouraging influences, and in the face of obstacles that would have entirely disheartened nine men out of ten. Van Depoele's life is full of lessons—so full, indeed, that if he had left nothing else behind him he would have been a great benefactor to his race and age.

Mr. Frankland Jannus, of Washington, D. C., has prepared with much care and labor a biography of Van Depoele, which follows. Mr. Jannus, who was for many years associated with Van Depoele in a legal capacity, is naturally more competent to perform the service of biographer than any one else.

Charles Joseph Van Depoele, electrician, was born at Lichtervelde, Province of East Flanders, Belgium, April 27th, 1846. At an unusually early age he showed that he possessed in a high degree the faculty of acquiring knowledge from what he could see and learn, and new things interested him greatly, especially in the domain of physics. His tastes were inherited from his father, who was for several years master mechanic of the East Flanders Railway Shops at Poperinghe. In 1856 young Van Depoele saw the telegraph system of the road put up, and from observation and inquiry learned all about the apparatus, and its operation while it was being constructed. He thereupon made apparatus of his own of the same nature, and at that early age read through all the books on natural philosophy and electricity to be obtained at the school which he attended.

Van Depoele was an exceedingly bright student, and stood well in his classes, but his father being a very practical man brought his school course to a summary conclusion at the age of thirteen, in spite of the appeals of his professor and the principal of the college, and apprenticed him to a cabinet maker, where he found long hours, hard work and a very, very small allowance of pocket money, about five cents a week. The study of electricty, however, seems to have taken complete possession of his mind, and instead of indulging in the sports common to most boys he spent his very scanty leisure in attempts to construct electrical apparatus. When fourteen years of age he constructed a Ruhmkorff coil with No. 34 wire using an automatic winder of his own design, and in 1861, at the age of fifteen, produced his first electric light, which excited great interest among his associates; but his father found it out, and, true to his prejudices, confiscated his books and destroyed the apparatus. Van Depoele was then put in charge of an uncle and aunt, to whom his desire for experimental work was explained, and they were requested to "keep him out of mischief," which meant to prevent him from making any progress whatever in electrical studies. Nevertheless, he made various attempts and was caught at one time making sulphurous acid.

At the age of sixteen he had mastered the trade of cabinet making, and was set up in a shop of his own, where he soon employed half a dozen men making all kinds of furniture. Still he seized every opportunity for study and actually constructed a Runsen battery of 40 cells, which was carefully hidden from his father between the joists of the top floor of his house, where it was left when the family moved to Lille, France, in 1864.

Van Depoele did not take kindly to the furniture industry, which his father established there successfully, and was allowed to secure a position in the sculpturing ateliers of Buisine-Rigot, where some 250 artists and artisans were employed. Sculpturing is here used as applied to carved wood-work. He was an unusually rapid, artistic and skilfull draughtsman, and in this congenial employment soon rose to the position of foreman and distinguished himself by making an altar for a church at Shanghai, China, a piece of carved wood-work 60 feet high by 40 feet wide. Van Depoele now was able to save some money, part of which he expended on electrical books and apparatus.

While in Lille, by his experiments and exhibitions of electrical apparatus which he had constructed he attracted the attention of Dr. Patoir, of that city, who commended him highly, and his father at last consenting, he attended the lectures and experiments at the Imperial Lyceum at Lille.

But his father and friends still objected most strenuously to his giving any practical effect to his electrical studies and research, and so he concluded to come to America where he would be free to gratify his tastes and work in the line which he preferred and believed would lead to a brilliant future. Van Depoele arrived in Detroit in June of 1869, and there, in connection with a Belgian friend, started the manufacture of art furniture, thus being a pioneer in that new great and prospering industry of the West. He made a specialty of church work, and many of the churches in that part of the country and in Canada were furnished throughout by him. Van Depoele was in straightened circumstances for many years after coming to this country, and he could spare very little from his regular business from which to purchase material for the construction of electrical apparatus. During the years 1869 and 1870, in Detroit, he constructed a printing telegraph apparatus, and also put up a battery of 100 Bunsen cells with which to exhibit an electric light, and he did give an exhibition during that year, but the cells gave trouble and he could only work his light for a very short time. During 1872 and 1873 he constructed apparatus and experimented with a Wilde machine, which he brought with him from France in an unfinished condition, also some magneto electric motors constructed at Lille. During the year 1873, hearing of Gramme's invention, he at once proceeded to build a Gramme generator, which was in his possession for many years thereafter. When this machine was completed he ran his Wilde machine as a motor from the Gramme generator.

His father who had followed him here, and his many friends objected to his persistent experimenting and wasting of money, as they were pleased to call it, and they actually met in council and demanded that he sign papers agreeing to give up his electrical experiments altogether. This meeting had just the opposite effect, and young Van Depoele swore that from that time on he would

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devote the whole of his time and money to the study of electricity. Accordingly, he placed his father at the head of his shop, he, Charles J., acting only as designer; and, building a little place of his own near his residence, worked altogether at developing his ideas.

From 1873 until 1878 Van Depoele worked in his annex laboratory, where he built several Gramme and also Alternating Current Dynamo Electric Machines, each one larger and more powerful than its predecessor, including a four coil open coil generator, which operated a circuit of 12 semi-incandescent lamps, which he made to go with it, together with a number of arc lamps, with which after a time he used to light up the furniture shop at night when the workmen required light. In the year 1876 he fitted up one of his dynamos as a motor, and with it ran the rip saw in the furniture shop.

In 1877 a public exhibition of his improved light was given in Detroit, and friends and money came to his assistance. After this he secured a building on Atwater street, in Detroit, which he fitted up and used as a laboratory until he removed to Chicago in December, 1880. The original Van Depoele Electric Light Company was organized in Detroit.

Van Depoele never restricted himself to electric lighting, either in his experiments or in his prospectus. What he contemplated and proposed was to apply electrical power to any purpose to which it could be made subservient; and in Detroit he frequently gave exhibitions of electrical possibilities; as, for instance, by connecting several pieces of apparatus together, so that it could operate simultaneously and each part be separately controllable. He did this many times with a group of four motors, which he had constructed and which were at that time available, and in this connection he frequently explained his electric railway inventions.

In 1878 Van Depoele illuminated Forepaugh's Circus during its exhibitions at Detroit, and on this occasion for the first time used carbon commutator brushes. He also lighted the Detroit Opera House with four large arc lamps, and fitted up a search light on a river steamer. By so doing he called down upon himself the wrath of other workers in the same field, one interested lawyer going so far as to break into his laboratory during Van Depoele's absence.

The great effort of electricians between 1877 and 1880 was to produce something which the public could use and appreciate—namely, electric light, and on account of strong competition Van Depoele and his friend, Mr. Albert Wahl, being convinced that their enterprise would be successful, considered it best to try another field, and in the latter part of 1880 he having then a tested commercial, direct current electric lighting system, moved to Chicago, where in a short time capital became interested and the Van Depoele Electric Light Company of Chicago was started in shops in the Springer Building, on Canal street, moving soon after to the Douglas Building. Here a factory was organized and men employed, and during 1881 exhibitions of the light were made gratis on some of the streets of Chicago, and the work of erecting and operating electric light plants went forward very successfully, and many thousand Van Depoele arc lights were installed in the surrounding country during the next two years.

Van Depoele was well ahead in the electric light business, and in 1882 they moved to and occupied the whole of the building, corner of Franklin and Van Buren streets. In the summer of 1883 he designed, constructed and subsequently sold what is believed to be the first 60 light arc dynamo that was ever produced.

Van Depoele had built several alternating current generators while in Detroit, and was working in that line also in Chicago, but the public demand was for direct current apparatus, and he was summarily stopped by his company. He, however, made and tested and exhibited a small two phase alternating current motor during the year 1882, which, so far as known, was the first of a now well-known class.

From his early familiarity with steam railways, the application of electricity as a motive power therefor, was often spoken of by him, and he recommended the use of electricity as a motive power for railways as early as 1873 or 1874, and during those early years he described to others (unfortunately now dead) several methods of conveying electricity to the moving cars by overhead and underground conductors. Van Depoele had the prevalent foreign timidity concerning anything legal, so that in those early years he was very much averse to making application for Letters Patent, and the early record of much that would have been valuable is therefore lost. A friend of his, however, strongly urged him to secure patents, and thus it happened that he became acquainted with Col. Thomas S. Sprague, of Detroit, Mich., who shortly before he died testified to the effect that Van Depoele explained to him as early as the fall of 1878 or spring of 1879 a complete system of overhead electric railway with power stations and system of distribution for operation between Detroit and Chicago.

Van Depoele's trials and tribulations in the early days in Chicago were numerous and great, and he constantly stayed up watching his circuits until the last lamp was put out and the last street car had turned in; then he had to walk home early in the morning. He did this with enthusiasm until his company realized to what an extent it was injuriously affecting his health, when they put a stop to it, and sent others in his place.

Notwithstanding this, in these early days, he urged upon his board of directors the fact that unless something was done in the line of demonstration of the applicability of electric power to locomotion, that others would step in and reap the benefit, and formally requested of his directors such permission, in a written communication early in 1882. In the fall of that year he finally secured the consent of his company to construct and operate a short piece of railway electrically, in a vacant lot opposite the factory. His plans were to equip and use a regular horse-car on the upward pressure trolley system, but the ground was frozen and his material was so delayed that in order to do something without further loss of time, he took what he could get for the time being, which was a hand-car, and this he extended and provided with seats and equipped with a motor belted to one of the axles. The car carried 20 persons. The conductor was a copper wire carried in slotted supports secured to the cross-ties and of a height which would permit the axles of the car to pass over them. The contact device comprised a pair of grooved brass wheels which were fixed to the under side of the car, front and rear, so that they picked up the conductor as they went along and dropped it again in the slots of the supports. The current was supplied from a generator in the testing-room of the factory to the conductor, which was picked up as stated, when after passing through the motor it was returned through the wheels and track. This demonstration was eminently successful, the car being operated from time to time for several weeks.

At the Interstate Exposition at Chicago during the month of September, 1883, Van Depoele exhibited his electric railway apparatus again on a small scale. On this occasion, one Sherman, had a car which had been used during the Railway Appliances Exposition in Chicago during the summer of 1883, and which illustrated by a short piece of track a form of suspended railway which Mr. Sherman was then exploiting. The supporting wheels of the car were on the top, and were carried upon rails laid on the top of an elevated structure, so that the car hung down, suspended from its truck. Van Depoele placed a motor on top of the car, and belted it to one of the axles. He then suspended two bare copper wires above the track and provided the car with two small trolley arms which engaged the conductor from below and supplied the current to the motor. It was very important that these contact devices should operate continuously, as the motor was connected in series with a circuit of arc lamps. Since the current could not be interrupted without extinguishing the lamps, this car was stopped and started by moving the commutator brushes, which were carried upon a rotable support controlled by two cords hanging through the roof of the car. This apparatus was operated during the exposition, and carried a great many passengers with entire success

During the following year Van Depoeple had an opportuntiy to make an exhibition of electric railway possibilities at the fair annually held at Toronto, Canada, during the fall. On this occasion he wished to try the underground method of distribution, so he built a conduit a little less than a mile in length, extending from the entrances to the main buildings. The conduit was a continuous wooden box slit longitudinally the whole length of the track. The box was held in place by iron brackets secured to the cross-ties and the edges of the slot were protected by iron strips. The conductors were placed on opposite sides of the box and current was taken to the motor on the motor car by two insulated conducting brushes which depended therefrom and entered the slot of the conduit. This

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electric railway operated with entire success and many thousands of passengers were carried during the fair which lasted about ten days.

The next year, however September, 1885, Van Depoele returned to Toronto and operated upon a larger scale. The railway of the preceding year was extended so as to make it of greater interest and more attractive to passengers, and instead of using the conduit, which was still in place, Van Depoele erected an overhead conductor free at its under side, as in the present well known trolley systems, and equipped his motor car with an upward pressure swiveled trolley arm, similar in principle to those used at the Chicago Exposition two years previously, and the first upward pressure trolley arm or pole used on a commercial scale. The track and conductor erected by Van Depoele were used every year for many years thereafter.

This Toronto railway included one train composed of a motor car with three trailers, and ran from the main entrance to and about the principal buildings. Fares were collected and over fifty thousand persons were carried during the ten days of the Exposition. High speed was attained, and every one connected with the installation was entirely satisfied that the electric railway had then and there become a demonstrated success; and it was in consequence of this exhibition that the Van Depoele Company determined to enter the electric railway field.

Shortly after this, in November, 1885, the first overhead conductor street railway in America was put in operation at South Bend, Ind., there being five cars on a single track road with turnouts. In this instance it was Van Depoele's intention to employ the same contact devices as at Toronto, but the officers of his company objected to the appearance of what they called a "Bean Pole" on a car, and he was obliged to use a contact carriage running along and carried by the trolley wire and connected to the car by a flexible "tow line" conductor. At South Bend he was met with the proposition, advanced by a local scientist, that he could not operate more than one motor car at a time. This imaginary difficulty was, however, quickly disposed of.

The Van Depoele Company now considered the matter of equipping street railways with electrical power as a regular business, in addition to the sale of their electric lighting apparatus; and with that end in view they exhibited a three-car train, one motor and two trailers, at the Cotton States Exposition at New Orleans. This railway was installed and put in operationg during December, 1885, using a steel trolley pole which was reversible upon its support, and, which was the first commercial trolley pole contact device used in the United States. The operation of this railway was entirely successful, and, with it as a basis, a contract was made early in the year 1886 to equip the lines of the Capital City Railway at Montgomery, Ala. This was first done on a short piece of track during the summer of 1886 for purposes of demonstration, at which time a contact carriage carried by the trolley wire was used, but when the order was given to equip the entire lines,steel trolley poles were constructed, together with switches such as are now in use, and the entire line was equipped on the under running contact principle, now known as the trolley. This was accomplished in the spring of 1887, and the entire city was operated by an electric railway including some 13 miles of track having 16 motor cars, the whole operated by the largest power dynamo of the time, 250 horsepower generator. This was the first commercial trolley road, and while it is now esay to pick flaws in its construction, there was nothing of the kind like it in existence during the year 1887, and the speeds there obtained were according to contract.

It is interesting to note that some of the first electric railways by Van Depoele, and others, reached speeds which have not since been permitted. At Toronto the Van Depoele train frequently attained the rate of 40 miles an hour.

During 1886 electric street-car lines were equipped, and put in successful operation at Minneapolis, Minn.; Appleton, Wis.; Detroit, Mich.; Port Huron, Mich.; Scranton, Pa.; St. Catherine and Windsor, Ontario, Canada.

In 1887, in addition to Montgomery, Ala., the Van Depoele Company equipped electric lines at Binghampton, N. Y.; Fort Gratiot, Mich.; Lima, O.; Wheeling, W. Va.; and Jamaica, L. I. And in 1888 the roads at Ansonia, Conn., and Dayton, O., begun in 1887, were opened to the public.

Better work would undoubtedly have been done on these early electric railways, but for the conditions imposed. The Van Depoele Company was required to bear the entire expense of equipment and experimental service, and was obliged in nearly every instance to utilize the track and cars of a pre-existing horse railway, which introduced many complications due to the structural weakness of the cars when power was applied thereto, with which a poor track greatly increased the difficulties, as will be easily realized.

The Van Depoele Electric Railway at Jamaica, L. I., was hampered from the start by an unusually bad track running along a much used turnpike road where the railway track was preferred by teamsters. This, in connection with a low bridge, was the reason why the company preferred to use the over running trolley; for, when the cars got off the track, as they very often did through no fault of the electrical equipment, they could more easily use their own power to replace themselves, through the long conducting cord, than would have been possible with a trolley pole. No electrical engineer would now dream of undertaking an electric railway installation under the conditions and at the prices the Van Depoele Company received, and these factors will account for many of the troubles incident to the early installations.

At South Bend., Ind., in November of 1885, Van Depoele placed his motors under the cars, and also used Carbon Commutator Brushes, but the modern form of car motor had not been evolved, nor would the railway people provide larger wheels for the cars so as to give room for the motors, as has since become universal. This led to the placing of the motor on the front platform, where it, together with its gearing and connections, was much more readily accessible and could be kept clean.

It was unfortunate for Van Depoele that his great achievement at Montgomery, Ala., was so far away from the business centres; yet most favorable notices can be found in the class publications of the day relating to the electric railway at Scranton, Pa., in a mountainous country where the grades to be surmounted in daily practice were something appalling.

The erection of so many electric railway plants seriously crippled the resources of the Van Depoele Electric Manufacturing Company, the result of which was that in the spring of 1888, the company sold out to the Thomson-Houston Company, and Mr. Van Depoele, removing from Chicago to Lynn, Mass., after which date the growth of the electric railway became phenomenal.

The carbon commutator or collecting brush, which is now used on electric motors throughout the world to the exclusion of the metal brushes previously used, is due entirely to Charles J. Van Depoele, who first used it on an arc light generator at Detroit, Mich., in 1878. It did not, however, give satisfaction then on account of the construction of the commutator. He tried it later with a quantity current machine, but the brushes got red hot on account of their resistance, and having been boiled in paraffine took fire, so they were replaced by the usual metal strips. He tried them again at South Bend. In 1887, however, in Chicago, Mr. Van Depoele exhibited a railway motor equipped with carbon commutator brushes under proper conditions. Here they were a perfect success, and furnished a solution of one of the most annoying problems in connection with the use of electric motors, especially in electric street railway work.

Soon after moving to Lynn Van Depoele equipped a railway motor with carbon commutator brushes, and although no one around him believed they could be successfully employed, he continued their use on the same machine for several consecutive weeks, the result after this test being such that the electricians of his new company, the Thomson-Houston, instantly recognized the immense benefit to be derived from the substitution of carbon commutator brushes for those of any other material for electric motors, at least, and they were at once adopted as the standard.

Mr. Van Depoele's inventions included many systems of current distribution for electric railways, among which may be mentioned the closed magnetic conduit, which invention he made as early as 1880 and for which he filed an application for Letters Patent in the spring of 1887. Another of his early inventions, since patented, comprised a conduit which had a surface slot normally closed by flexible material, the current being collected by a thin knife-like plow, which extended between the slot closing material into engage

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ment with the conductor, in connection with which a circulation of air was maintained within the conduit for the double purpose of improving the insulation and excluding moisture.

A later conduit system of Mr. Van Depoele's includes a tubular conductor placed in any convenient way within a slotted conduit, such for example as a cable conduit. This tubular conductor is enveloped in insulating material, and provided with a continuous series of inwardly movable contacts which might be called push buttons. A current collector carried by the car extends down through the open slot of the conduit and presses against the push buttons, forcing them inward into contact with the uninsulated interior of the tubular conductor, thereiy collecting current from the inside of the conductor as the device engages them. The conductor by this method is entirely protected from water or anything which may enter the conduit, being entirely covered with insulation, and the contact device carried by the car for pushing in the buttons, and so completing the motor circuit is simplicity itself.

He also devised several forms of a system for operating entire trains, in which each car or a number of cars in the train are provided with motors, all the motors being controlled from a single point, so that trains might be increased in length without requiring a correspondingly heavy locomotive. Mr. Van Depoele was a born inventor, and when he had brought an invention to the point where the development of the details could be entrusted to others he invariably dropped it for something new.

An Electric Mail Carrier was another of Mr. Van Depoele's inventions, which he devised during the year 1882. The system included small freight carrying vehicles which were carried along a strong, suspended cable and driven by motors in the vehicles acting upon grooved wheels which supported them upon the cable, the cable itself to be of metal, so as to carry the vehicles and also to supply the current. During the summer of 1884 Mr. Van Depoele constructed a working model, using a cable some 90 feet long, and in January, 1885, he put up a full-sized working specimen of this invention in a vacant lot adjoining the factory on North Clinton street, Chicago, and also equipped the same with automatic stopping and starting devices at each end, so that the Telpher car ran backwards and forwards without any attention whatever so long as current was supplied. This device often carried a load and fully demonstrated its practical capacity, which undoubtedly will be brought into commercial use before long.

Mr. Van Depoele's idea in connection with this invention was, that a heavy pole line could be built in rough or mountainous country for a small fraction of the cost of a railway, and that it would be capable of carrying a very large amount of freight at a comparatively small expense, since the track would not be liable to be blocked by snow, landslides or washouts.

During the year 1885, Van Depoele applied the solenoid principle to coal mining machinery, and produced some electrical coal cutters of the reciprocating type, for undercutting coal, which were subsequently tested in the mines at Streator, Ill. These devices were of the continuous current type, and the sparking of the commutators was very objectionable; whereupon, during the same year, he devised the commutator less non-sparking reciprocating engine, which operated with continuous currents rising and falling in the motor coils, the rise and fall of current being effected at the generator. This invention, however, was obliged to remain in abeyance for a time, in favor of the electric railway which the Van Depoele Company was very anxious to press forward.

During his residence in Lynn, when electric railway constructions had been reduced to standards, he again took up the application of electricity to reciprocating engines, such as are used in rock-drilling, and in this line he had made great progress at the time of his death.

The trials and tribulations attending the introduction of a new art is something known only to those who have been personally involved. The fact that skilled assistance is not attainable will give at once an idea of the disadvantage under which a pioneer works. Everything has to be done new, many things are experimental, and an art seems to be evolved only by trying everything and discarding those things which are not of the best.

If Van Depoele had been surrounded by a corps of competent assistants in the early days, and a competent financial management, he would have accomplished much more and would have brought many of his inventions before the public at an earlier day. Great credit is due to those of his early employees who learned the art and stuck to him through thick and thin in spite of temporary failures and disheartening disasters; and who, caring not for hard times, exposure and labor of all kinds at all times, remained faithful until those of his inventions which were brought before the public were put into successful operation, so as to absolutely demonstrate the great possibilities before them.

It must be remembered that the electric railway was developed by Van Depoele, and his men before the day when college students went into the art, and that Van Depoele, therefore, had no expert outside assistance, but was obliged to rely upon his own inventive genius for every piece of apparatus. He was told time and time again that his ideas were chimerical, and in his first American railway at South Bend, Ind., the local professor almost frustrated his plans by announcing that two electric motor cars could not be made to go in opposite directions upon the same track. It takes more than ordinary grit and perseverance to overcome such obstacles as these, but Van Depoele did it and did it in spite of the skepticism even of the management of his company, and to him belongs the credit.

After he joined the Thomson-Houston Company the obstacles which had so seriously impeded his progress disappeared, and many of his inventions which had remained in abeyance for lack of means to give them effect were developed and exploited, and it is sad to think that so useful a man should have been cut off in the prime of life when after achieving success in spite of the greatest difficulties, his abilities had been recognized by the most powerful and progressive electrical corporation of the country, in whose service he had all the means to carry forward his plans that any man could wish. His death was a great loss, not only to those who knew him, but to the electrical art everywhere.

Almost all of Mr. Van Depoele's work had been done in the West and in Canada, and the exposure incident to working at all hours in all weathers seriously affected his general health. His last illness was brought on by a trip to Block Island, Minn., in November, 1891, where a number of his electric rock drills were being used by the government in removing obstructions in the Mississippi River. On this occasion he left the beautiful fall weather of Massachusetts, and after two nights in overheated sleeping cars landed at four o'clock in the morning in a temperature of 150 below zero. He caught a severe cold, which with complications arising therefrom sent him to bed on his return home. He almost recovered from this attack, but unfortunately while convalescing caught another cold which attacked his lungs and was the ultimate cause of his death, March 18, 1892.

"Charlie," as he was known to his friends, was a genial, whole-souled fellow, full of fun and humor, quick-witted, active and progressive. He had the faults of his qualities, was nervous and high strung, and like many inventors was mentally incapable of giving that attention to detail which belongs to the industrious mechanic. He made many friends and kept them. His determination of purpose under adverse circumstances was simply remarkable, and he needed it all to accomplish what he did, for the path of the pioneer is full of steep grades and sharp curves, as none knew better than he.

Frankland Jarvis

Washington, D. C., March 14, 1896.

ELECTRICITY IN CHINA.

Answering the critic who recently said there was neither electricity nor a disposition to use it in China, the *China Gazette* says:

"A couple of years ago there were only about seven miles of streets lighted by electricity, for which 60 arc lamps were quite sufficient, and there was not a single incandescent lamp in or around Shanghai. Now it appears the electrical department of the Municipal Council runs 140 arc lamps, lighting some 15 miles of streets, and there are about 43 miles of line wire laid, in addition to 6,100 incandescent lamps of 8 candle power each, for domestic purposes."

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NEW STELL ARMORED CONDUIT.

For a long time attempts have been making to design a conduit of iron or steel, flexible or so shaped that "ways" could be fitted to walls and ceilings, and with a lining made of some material that would tend to solve the problem of insulation, fire protection, permanency, and that would be proof against destructive electrolysis. It is claimed the Osburn conduit meets all these requirements. It is made in three grades. One variety is designed especially for buildings, the interior of which are constructed of wood. This particular type of conduit is made of galvanized steel tubing having a lock seam, the seam being thoroughly galvanized so that it is water tight.

The lining of these tubes is composed of vitrified stone ware. This is made of a particular material which when subject to a temperature of some 4,000 degrees of heat for five days, becomes thoroughly vitrified and is non-absorptive. The reason this particular material is used is because it possesses the quality of being both fireproof and insulating, and possesses extreme toughness. It is not effected by water or age, and will last for ages. It is quite important that in the construction of conduit that the sizes of the conduit remains the same, so that the wires can be readily inserted or withdrawn. There is nothing in this lining that will become softened by a change of temperature and adhere to the wires, as the wires can be readily withdrawn at any time. They are manufacturing this variety in sizes from ½ to 1½ inches.

The terminal boxes, junction boxes and switch boxes are also lined with the same material, also the elbows, making them absolutely fireproof. These boxes have a spun metal cover which fits closely. The switches are concealed in these boxes.

There is also a flat or elliptical conduit. It is made in this shape for the purpose of running down the side of walls underneath the plaster line. It is nine-sixteenths of an inch thick, and an ordinary plaster line being five-eighths of an inch, it will easily cover. It therefore saves the trouble of cutting away the stone or brick wall. For fireproof buildings it can be run along the tiling, and put in after the tiling has been installed.

There is considerable labor saved in this particular shape of conduit, and it is easily installed. It is provided with elbows for the elliptical conduit, also special corner boxes.

This is lined with the vitrified stone ware, and has an opening similar to the junction boxes, but smaller.

The wires can be drawn through the box, and redrawn in the other direction and used in place of the elbows as the elbow would project into the room whereas in the corner boxes all that is seen is the plaster, as it has a small cap that is about 1½ inches in diameter.

There are junction boxes and outlet boxes made up to receive the elliptical conduit. In the place of threading this conduit metal sleeves which fit the steel armor closely are used, and the conduit is put end to end and the sleeve is extended from the joint; the joint is then soldered or leaded, making a most perfect joint and one that is quickly made.

The elbows are so designed that they will receive the main conduit at each end, thereby saving a sleeve at the elbow.

There is also provided a converter which is used for converting from the round system to the elliptical. In case the round conduit is used in the principle construction of the work, and it is desired to run at the outside of wall, where it is firm, it is converted from the round to the elliptical or vice versa.

A heavy steel armor is used for fireproof and iron structural buildings. This can be used in connection with either of the other two styles or a complete system can be installed, where a greater strength is required. For the average building the lighter tube will answer best.

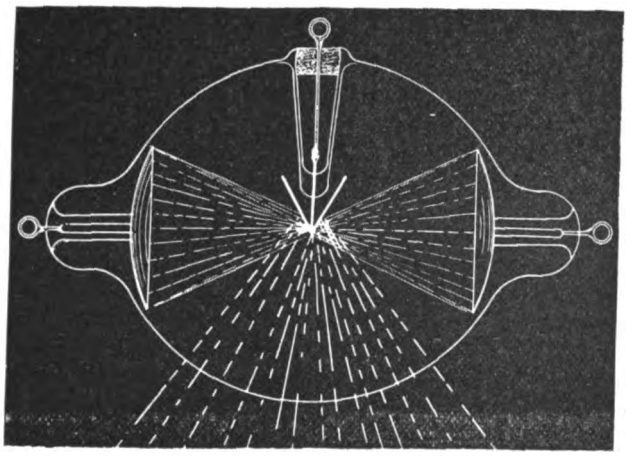
This conduit can be finished in any style or manner, enameled, grained, or plated, and for exposed work making a handsome appearance.

The conduit having a lighter steel can be installed without special tools, and can be installed by any one having had experience in electric wiring. The heavier steel tubing is put together by threading the ends.

PROPOSED TUBE FOR ROENTGEN RAYS.

By Elihu Thomson.

The observations which have up to this time been made as to the source of Rœntgen rays point to the fact that the cathode rays must strike some surface which then becomes the Rœntgen ray source. My own observations make me think that if the bombarded surface is of such a dense metal as platinum, which does not fluoresce, the rays will be more energetic. Bearing in mind these observations, and the fact that it is desirable to possess Crookes tubes which are of standard make, and adapted for use with high frequency apparatus, Ruhmkorff coils with oscillatory or uni-directional discharge, or with Winshurst or Holtz machines, I have proposed as a standard tube one which is represented in the accompanying illustration. The structure consists of a bulb, at opposite sides of which are mounted concave aluminum discs supported on wires sealed through the glass. The foci of these concave electrodes coincide nearly at the centre of the bulb, at which point is located a V-shaped sheet of platinum, iron, a small piece of iridium, or other piece of metal.



This could be supported in any way desired, but it may be suggested, as a convenience, that it be mounted on a third or middle terminal, so that it can be made an anode. In using this tube with high-frequency currents the two cup-shaped terminals are attached to the source of electric currents, which alternately become cathode during the discharge and cause the Rœntgen rays to be emitted from the apex of the platinum sheet or from the surface of the piece of metal placed at the common focus. With oscillatory currents from a Ruhmkorff coil the same connections may be used, and even when the discharges are uni-directional the connection of either cup-shaped terminal as a cathode makes the tube effective, but in this case the middle terminal may be made the anode and the other or cup-shaped terminal a double cathode, and thus give the greatest amount of cathode surface with but a short distance to be traversed by the discharges, while the sharpness of the focus, and, consequently, the definition obtainable with the Rœntgen rays remains unimpaired. If the vacuum in such a tube is too low, it is also possible to raise it quickly by constituting the middle terminal a cathode for a time, in which case metal would be carried therefrom and deposited on the side of the bulb in a very fine state of subdivision and quickly absorb the residual gas. If during the working of the tube the vacuum becomes too high it can sometimes be reduced by simply heating the tube to a high temperature.

If President Cleveland could be given just one X-ray view of what the country at large thinks of him and his administration, the negative would convince him, we think, that duck shooting, or crap shooting should be mighty entertaining sport until after the "ides" of next November.

J. J. Borrup, of Terril Road, has a very sick cow. Yesterday Dr. Herbert shed the X-rays in the animal and found her suffering from "impaction of the third stomach." The cow will get well.—Plainfield, N. J., *News*.

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BIG PLANT COMPLETED.

The Folsom-Sacramento Long Distance System Turned Over to the Owners.

General Electric Company's Big Contract.

The completion of the power transmission scheme between Folsom and Sacramento is the conclusion of a vast enterprise, undertaken in doubt and terminated in a success which has, as it were, galvanized the State of California, and demonstrated not only the tremendous resources at its command, but also the feasibility of electrical transmission over long distances commercially.

The scheme as first conceived by Mr. Livermore, President of the National Water and Mining Company, contemplated nothing more than the building of a dam across the American River at Folsom for the storage of water and the irrigation of the lands lying in the Sacramento Valley. For twenty-five years intermittent efforts were made to carry out the scheme, and but little progress was effected. Calculations had also been made looking to the utilization of the power derivable from the difference in level of the water, and estimates had placed the possible power available at Folsom extremely high, while dreams of a huge manufacturing city to utilize this power at that point were indulged in, but the result turned out differently, and instead of the factories being brought to the power, the power is now taken to the factories.

In 1881 the rights of the old company, presided over by Mr. Livermore, were taken over by the Folsom Water Power Company. Work had been begun on the dam, but the development of the scheme appeared so costly that not until the company made a contract with the State of California, whereby convict labor for the construction of the dam, and canal was exchanged for the site of a State prison, and a certain amount of power, was the work really put under way. In 1888 this contract was signed, the plans were expanded, and under these new plans work was begun in earnest.

The dam is a massive structure of granite laid in Portland cement. It is 650 feet long, 89 feet high in the centre, 87 feet wide at the base, 25 feet wide at the crest and contains about 48,590 cubic yards of solid masonry. It is provided with a heavy wooden shutter or flashboard six feet high, which at high water is lowered into a recess in the crest of the dam. At low water this shutter is raised by hydraulic pistons, the depth of the basin is increased by six feet, and additional storage capacity provided. Normally the dam forms a storage basin or reservoir three and one-half miles long with a capacity of 13,000,000 cubic yards of water.

At each side of the dam are massive granite bulkheads, and three head gates operated by hydraulic machinery, each headgate 16 feet wide. The canal on the west side intended principally for irrigation is not yet completed.

The east side canal is divided into three sections. The first, stretching as far as the State Canal, where the water falls about seven feet, is cut out of the solid granite and extends a distance of 2,000 feet. The second section is 4,000 feet long, and on the completion of this the terms of the State labor contract were fulfilled. Thus far the canal is built along the face of the cliff. The third section of the canal is an earth ditch, excavated by the Folsom Water Power Company, and is 3,000 feet long. The outer wall of sections two and three carries a broad gauge railroad track.

The total length of the canal is 9,500 feet. Section 1 is 53 feet wide on top and 45 on the bottom. Sections 2 and 3 are each 50 feet wide on top and 40 feet on the bottom. The depth is 8 feet. All the water passes through the State Power House, through Leffel turbine wheels, developing some 800 H. P., used for air compressors, electric lighting and other purposes. Thence the water continues on to the Folsom Power House, at the side of which is an immense log basin. Here the jurisdiction of the Folsom Water Power Company ceases, and that of the Sacramento Electric and Power Company begins.

The power house is built on the site of an old placer gold mine where a fall of 55 feet is available at high water. It is on the west side of the town of Folsom, cut about 60 feet deep, 100 feet wide and 150 feet long, from which a channel 40 feet wide leads down to the river. At the power house the canal makes a sharp turn at right angles and widens out into a forebay 150 feet long, 100 feet wide and 12 feet deep, which forms a settling basin for debris. It is divided into two parts by a stone wall provided with suitable gates, so that one side may be cleaned out while the other is in operation. At the lower end of each section of the bay a sluicing gate connects with the lower river by a sluicing canal, and through these the sand and debris are carried away and kept from the wheels. The hydraulic apparatus manufactured by S. Morgan Smith, of York, Pa., consists of four pairs of 30-inch wheels of the McCormick horizontal shaft turbine type, each pair of 1,260 H. P. capacity at 300 revolutions operating under a head of 55 feet. The steel penstocks are 8 feet in diameter, and each wheel has two draft tubes. The governors are of the Faesch-Licard type, and these are assisted by heavy fly wheels fitted to the water wheel shafts. The hydraulic plant also includes two special horizontal wheels for the exciters. The water after having passed the turbines is discharged into a tail race canal, which will distribute water for irrigation over the country south and west of Folsom.

The power house is a two-story brick building. The water wheels are placed in the open air between the forebay and the wall of the structure, through which the turbine shafts pass. To each shaft is coupled a 750 K. W. (1,000 H. P.). General Electric Three Phase Generator—the largest of their type yet constructed. Each is a 24 pole machine delivering current at 60 cycles 800 volts and running at 300 R. P. M. The exciters are 4 pole 500 volt 30 K. W. generators, either one of which is of sufficient capacity to excite the fields of all four generators. From the generators the current passes to the generator switchboard, and thence to nine step up transformers in the upper story of the power house. The capacity of each transformer is 250 K. W. They are cooled by an air blast from blowers driven by induction motors. In these transformers the pressure is raised from 800 volts to 11,000 volts, and the current passes to the high tension transmission lines carried out of the power house through porcelain lined holes in the wall.

The switchboards are of Tennessee marble, and are so arranged that the generators may be run in parallel or on separates lines as may be desired. The generator switchboard carries the necessary switches, instruments and other apparatus for synchronizing the generators. The boards in the transformer room carry switches for the high and low tension, sides of the transformers and switches and current indicators for the transmission lines.

The pole line is double throughout, and follows the high road from Folsom to Sacramento a distance of 24 miles. Each pole carries two cross-arms for two circuits, each circuit consisting of three bare copper wires supported on double petticoated porcelain insulators, especially designed and made for this installation at the porcelain factory of the General Electric Company at Schenectady. Each insulator, before shipment, was exposed to a test of not less than 25,000 volts alternating. Each circuit can carry the output of one dynamo, and any dynamo can be thrown on any line. The loss is calculated 7.5 per cent. when transmitting 3,000 H. P.

The telephone line is carried on the same poles as the transmission line and connects the power house with the sub-station in Sacramento. The transmission lines being spiraled every mile, and the telephone wire transposed every fifth pole no induction is noticeable on the telephone circuits and conversation is not in any way interfered with.

The sub-station is a fire proof two-story brick building on the corner of Sixth and H streets, Sacramento, having the transformers on the second floor and the dynamo room on the ground floor. In the transformer room the high tension switchboards receive the terminals of the 10,000 volt lines, and operate the different combinations of the step-down transformers. These transformers also ventilated by blowers vary in size according to the duty required of them, the secondaries delivering current at 125, 500 and 1,000 volts. They number twenty-one, fifteen of 125 K. W., and six of 40 K. W.

The transformers are connected to high and low tension switches on the boards and from these the current passes to the distributing boards or the synchronous motors, power circuits and incandescent lighting.

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In the main or dynamo room of the sub-station a line shaft runs the entire length. To this are directly coupled, through friction clutches, three synchronous motors, each of 250 K. W. capacity, wound for a potential of 500 volts and run at a speed of 450 revolutions. To the line shaft are belted one 200 K. W., and one 90 K. W. multipolar General Electric Railway generators and two 1,000 K. W. Edison bipolar machines, all of 500 volts and three 100 light and two 75 light Brush arc machines.

In this room are also the switchboards for controlling the synchronous motors, the railway generators and circuits and the arc dynamos.

For the operation of the synchronous motors 750 K. W. of transformers capacity is utilized, the balance being used for low and high tension distribution. The low tension current is distributed by a three phase four wire system, combining the three phase and Edison three wire systems—that is, three wires for the three phase current and a fourth or neutral wire. Incandescent lights are connected between the neutral, and any one of the three other wires, while motors are connected to the three phase wires, giving at the mains 115 volts for lamps and 200 volts for motors. The feeders for this extensive system pass from the sub-station through a distributing switchboard which carries potential regulators for maintaining constant pressure at the mains. Additional circuits run from the sub-station at 500 and 1,000 volts supplying current for lights and motors in the more distant parts of the city.

Power was transmitted for the first time from Folsom to Sacramento on July 14th, 1895, for the operation of the Sacramento Street Railway. On September, the 9th, a grand carnival was held to celebrate what up to the present is the longest commercial power transmission ever effected. The balance of the machinery has since been set up, and the installation is now complete.

The transmitted power not only operates the Sacramento Street Railway, and lights the entire city, but is also used extensively for almost every conceivable power purpose.

The largest consumer is the Street Railway, which over 24½ miles of a single and 17 miles of double track operates 32 motor cars and trailers. The Southern Pacific Railway shops are in Sacramento, and employ a large number of motors, and each day the demand for power in the city generally grows, as the inhabitants of Sacramento realize the benefits which cheap power can confer.

The entire equipment was carried out by the General Electric Company, whose apparatus is exclusively employed.

This plant is a complete illustration of the possibilities of electric transmission, every problem to be met with in transmitting power over long distances at high potentials, and utilizing it for all industrial purposes having been solved successfully.

COPPER BUSINESS FOR 1896.

As the price of iron shows the mercantile condition of any country, or the world at large, the price of copper may be taken as an indication of activity in the electrical and allied industries. The improved business condition of Europe during 1895 had a marked influence on copper, and advanced its price materially. While South America, Africa, Austraiia and Asia consume some of our copper for wire and a little for raw material, we are almost dependent on Europe to dispose of our excess of production.

There is now a sharp call for copper everywhere, and a promise of still better business as the busy season of spring and summer opens up. The production in the United States for the first three months of this year amounted to 51,510 long tons, as against 38,567 tons in the corresponding period of last year, showing an increase of 12,943 tons, in other words about 33 per cent. This increase has not been consumed, or any part of it, in this country, the consumption at home having remained stationary, or nearly so, thanks to our "mad" Congress. The exports, however, for the first quarter of the year were 27,356 long tons, as against 13,786 tons for the first quarter in the past year; an increase of 13,570 tons, or about 98 per cent. To show that this largely increased export was easily absorbed by the consumptive demand, it is only necessary to refer to the statistical figures of stocks in Europe and afloat, being on the first of April 39,950 tons, and on the first of January of this year 45,790 tons, showing a decrease of 5,840 tons which have gone into consumption. The foreign production has remained practically stationary, being for the first quarter of 1895 20,840 long tons, and for the same period in 1896 20,900 tons. Therefore the improved price does not seem to have stimulated foreign production, but should the demand continue we have full confidence in the resources of our various copper producing districts to meet it.

GENERAL ELECTRIC REPORT.

The statement for the year 1895, just issued by the directoryof the General Electric, is a more satisfactory showing than was to have been expected, in view of the close finances of the country. It shows more business than was done the previous year by about 10 per cent., and fair profits. It shows a good deal of work now under way, and, above all, it shows the balance on the right side of the ledger, with comparatively small liabilities excepting in stock and bonds, and a very small amount in unpaid bills. These annual reports are always largely matters of book-keeping, but the investor, reading what is in black and white, will feel better about the general electrical condition of the country.

It has been customary in business circles to gauge the business situation by the prices and demand for iron. There are many reasons why a closer tally can be arrived at by taking the electrical business as a basis. Commercial electricity is yet so new that new business means new construction—not repairs as a rule, and usually construction that might wait on a healthy feeling. It is certainly a fact that electrical interests suffer first when things begin to tighten up, and this report shows that things are beginning to loosen up in a direction that means a general brighter outlook.

Boom times are not here, but there is a mighty suspicious rumbling that sounds well.

AMERICAN INSTITUTE MEETING.

At the 105th meeting of the Institute held at 12 West Thirty-first street, New York City, April 22d, and about 200 members and guests were present. A paper was read iy Mr. D. McFarlan Moore, of Newark, N. J., on "Recent Developments in Vacuum Tube Lighting." It was accompanied by numerous experiments, and the hall was lighted with tubes, which were suspended horizontally from the gallery in a double row.

At the meeting of council in the afternoon the following associate members were elected: Bert L. Baldwin, Cincinnati, Ohio; Chas. M. Clark, 831 Madison avenue, New York City; William J. Clark, General Electric Company, 44 Broad street, New York City; Henry G. Field, 25 Hodges Building, Detroit, Mich.; Curtis B. Flory, 530 Broad street, South Bethlehem, Pa.; Chris. M. Goddard, 55 Kilby street, Boston, Mass.; Wm. S. Jackson, Duncannon, Pa.; C. W. G. Little, 38 Parliament street, London, England; Chas. P. McClure, Bell Telegraph and Telephone Company, Richmond, Va.; Buckner Speed, 1521 Fourth street, Louisville, Ky.; Robert M. Thomas, 222 West Twenty-third street, New York City; Alfred A. Thresher, Dayton, Ohio. And the following associate members were transferred to membership: W. S. Andrews, General Electric Company, Schenectady, N. Y.; Henry G. Stott, Buffalo, N. Y.; Henry S. Carhart, Ann Arbor, Mich.; and Russell B. Harrison, Terre Haute, Ind.

CARD COMPANY'S GOOD CONTRACT.

The Board of Managers of the Ohio State Reformatory have awarded the Card Electric Company, of Mansfield, Ohio, the contract for two direct connected multipolar generators, capacity 66 K. W. each, speed 250 R. P. M. for use in the Ohio State Reformatory, Mansfield, Ohio, for lighting purpose. The generators will be direct coupled to Ball engines.

Competition for this work was quite keen, and naturally the Card Electric Company's hustlers are a good deal tickled with themselves.

Farmer Corntossel says he would just as lief be shocked by a live wire as to have a bloomer girl ride by the farm. The sensation in the two cases is the same. He considers them connected in parallel as it were.

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THIS IS WHAT WE WILL SEE

The National Exposition at New York Will Demonstrate What Has Been Done Since the World's Fair.

SOME EXHIBITORS AND THEIR WARES.

The electrical people are looking forward with a good deal of interest to the exposition to be held in New York, beginning with the date of meeting of the National Electric Light Association, and continuing during the month of May. While there will not be an effort in the direction of size, yet it is understood that there will be shown practically every new thing, invented since the Chicago World's Fair. Many of the exhibitors will be recognized as among those that made the great exposition a mark for future expositions to strive for. While yet many of them are new some of the principal ones follow:

THE BRUSH ELECTRIC COMPANY.

The space of the Brush exhibit comprises 425 square feet.

The exhibition will be composed of a historical exhibit and a modern exhibit: the former of which is very old and the latter very new.

The historical exhibit will consist of the first Brush arc dynamo, which was sold in 1877 to parties in Baltimore, who ran it for twelve years. A sixteen light 2,000 candle-power arc dynamo, which was run by the Fulton Worsted Mills, Fulton, N. Y., from September 1st, 1879, to April 10th, 1892, when it was secured for exhibition at the Columbian Exposition. A forty light Brush arc dynamo, which was operated by the Berkeley Company in Providence, R. I., from December 1st, 1881, to May 19th, 1893, when it was purchased for exhibit at the Columbian Exposition. These dynamos are exhibited just as they left the factory years ago. Not a bobbin of an armature has been rewound or a shaft wire or a commutator replaced.

The working exhibit will consist of a new eighty light 2,000 candle-power Brush arc dynamo connected direct to a 60 K. W. 220 volt motor. Eighty double Brush arc lamps will be hung gracefully around the exhibit and operated from the direct connected dynamo.

In connection with the direct connected eighty light arc dynamo will be shown in practical operation a machine running with a load of eighty lights with a difference of potential not exceeding 1,500 volts between any part of the machine or circuits and the machine still maintaining its automatic regulation. To put it more plainly, three circuits will be run direct from the terminals of the dynamo, on any one of which circuits the voltage will not exceed 1,500 volts, or in other words on any one of which circuits there will not be more than twenty-seven 2,000 candle-power arc lights. This is an entirly new method of running lamps on an arc dnamo, and will be exhibited for the first time in the Brush exhibit. There will be a one hundred light 2,000 candle-power Brush arc dynamo, and a one hundred and twenty-five 2,000 candle-power Brush arc dynamo exhibited. These three large arc dynamos are of the very latest Brush type. They have been recently designed by the Brush Company, who have already sold over 20,000 lights capacity of them.

A rack of the various styles of lamps which the Brush Company manufacture will also be exhibited.

COMBINATION EXHIBIT OF THE ELECTRIC STORAGE BATTERY COMPANY AND WESTERN UNION.

Quite a unique exhibit of long distance transmission from Niagara Falls, and coincidentally a storage energy exhibit, will be made. The Western Union Company volunteered to set aside two wires from the Niagara Falls power plant to transmit current for running the model plant at the exposition. These wires will be available in the evening, and the question thus arose as to what should be done in the way of running the model the rest of the time during each day. Mr. A. S. Brown, the electrical engineer of the Western Union Telegraph Company, suggested that it would be a comparatively easy thing to ship a few storage batteries up to Niagara, charge them there and bring them down for the purpose. This suggestion has been acted upon, and the Electric Storage Battery Company, of Philadelphia, through Mr. Charles Blizard, its representative in New York, has placed at the disposal of the exposition all the batteries that may be needed, with the permission that this stored Niagara energy can also be turned loose on any other exhibit at will. There will thus be exhibited the energy of Niagara in a "live" form, coming over the wires in the shape of an alternating current to drive the model by an alternating current motor; and the stored Niagara energy, which will be applied to a direct current motor, which will also run the model part of the time. A more interesting illustration of the flexibility of electrical power transmission than this could hardly be desired, as it practically embraces the whole field of modern methods and appliances.

THOMAS A. EDISON.

This will be a personal exhibit of Mr. Edison's, distinctly a courtesy to the exposition, and in the interest of its success. It will be general in character. In telegraphy it will consist of stock printers, the phonoplex, the quadruplex, American District system, train telegraphy and rote recorder, the first invention Mr. Edison ever made. In telephony he will show several varieties of apparatus, including microphones, the chalk transmitter, motograph receiver, etc. He will also show his interesting megaphone, odophone, etc. In lighting, Mr. Edison will show his earliest incandescent lamps, first converter, models of system of distribution, multiple carbon lamps, centre pole lamps, first chemical meter, lamp Leyden jar, platinum lamp, etc.; also the first fixtures used. In the line of power transmission, Mr. Edison will exhibit some very early motors and models of great interest. Among miscellaneous exhibits may be named his pyromagnetic motor, etheroscope, tasimeter; the various stages in the evolution of the bamboo fillament; magnetic friction devices; his early and latest phonograph, also his recent fluoroscopes. He has also in course of construction four sets of apparatus with which experts from his own staff will give exhibitions of the Rœntgen rays, so arranged that by using the fluoroscope put into the hands people can inspect their own anatomy. The Crookes tubes will be mounted in connection with mercury pumps, so that in a rough way the process of lamp exhaustion will also bedemonstrated.

GOLD AND STOCK TELEGRAPH CO.

One of the most generally interesting exhibits will be that of the evolution of the "stock ticker." To watch the tape unroll with the curt little signs on it is one thing, but to see how the information that means so much to the financial world is gathered and put on the circuits is another matter of interest to everybody. The development of the modern stock-ticker system, so strikingly American, is the result of much ingenuity and enterprise, and has brought many brilliant electricians to the front. With the object of assisting to a better understanding of the subject, the executive of the Gold & Stock Telegraph Company has generously authorized its superintendent and electrician, Mr. George B. Scott, to place at the disposal of the exposition management a number of old instruments that will be useful in showing how the system, as it exists to-day, has been worked out to its present stage of efficiency and celerity. Mr. Edison and others are also contributing apparatus of this nature, rendering the display one of unusual value, as such electrical machinery has never been brought together before in this instfuctive manner.

THE GENERAL ELECTRIC COMPANY.

The big company will occupy about 400 feet of space so laid out that he exhibit can be shown to the best advantage. The prevailing feature of the exhibit will be the headquarters of the company, and its committee of officers which will be in charge to see that people are taken care of after they reach the building. This convention committee of the company will probably be present during the exposition period. This committee consists of S. D. Greene, Chairman; Charles T. Hughes, Vice-Chairman; Fred. M. Kimball, Secretary; A. D. Page, lamp works; T. Beran, of the New York supply department, and F. N. Boyer, of the Chicago supply department. In addition to these gentlemen the company's representatives from Philadelphia, Chicago, Atlanta and Boston, and some

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from the railway, power and mining departments, and the New York office will be in attendance.

As a still exhibit the company will show a few of its latest long-burning arc lamps, a selection of its inclined coil instruments and a few meters.

INTERIOR CONDUIT AND INSULATION COMPANY.

Brother Johnson's Company will show in operation a printing press run by direct-connected Lundell motor; exhaust fan outfits; 60 inches, 36 inches and 12 inches; direct-connected generating set; Lundell power motors. Lundell generators, Lundell desk fan motors and ceiling fan motors, Lundell dental outfits, Lundell emery wheel grinder, Lundell buffing machine and Lundell organ blowing outfit. The latter outfit will be attached to a Mason & Hamlin organ, which will be played each evening. The company will exhibits its complete system of plain, brass armored and iron armored insulating conduits, as well as its complete underground conduit system. It will show an illuminated sign 30 feet in length. The following named gentlemen will be in attendance D. C. Durland, George H. Kimber and E. B. Kittle.

THE ADAMS-BAGNALL ELECTRIC COMPANY.

A good deal of interest attaches to the exhibit that these folks will make, as they are new people, full of business, push and resources. They will have on exhibit and in running condition 1 black japan series lamp, shunt; 1 seventeenth century brass series lamp, differential; 1 oxidized copper 100 hour lamp; 1 aluminum 100 hour lamp; 1 yellow brass alternating lamp, 1,600 alternations; 1 Japanese copper alternating lamp, 7,200 alternations; 1 oxidized silver constant potential lamp; 1 oxidized brass constant potential lamp; 1 marine lamp, black Japan; 1 100-hour old gold lantern, also 1 nickel railway lamp to run 9 or 10 in series on the railway circuit, all of the improved "A-B" pattern. The "A-B" incandescent lamp will also be shown. Testing instruments will be in circuit, and any of the above-mentioned lamps will be subject to test at any time during the exposition.

PATENT OFFICE EXHIBIT.

In view of the location of the exhibition, the exhibit of the United States Patent Office at the National Electrical Exposition will be made one of unusual size and interest. As now arranged by the department, under the instructions of Mr. S. T. Fisher, the acting commissioner, it will include no fewer than 361 separate models of electrical devices, apparatus, machinery and appliances, many of them embodying the fundamental and elementary ideas upon which the modern electrical arts have been founded. These models will occupy over 300 linear feet, and will be carefully grouped and classified, so that students, of whatever character, can follow the general lines of growth or evolution.

PATRICK AND CARTER COMPANY.

This house will exhibit a general line of house goods consisting of hotel and house annunciators, burglar alarms, hotel fire alarm systems and return calls, and also a full assortment of bells, pushes, and numerous other household electrical appliances. The company will have in operation a complete line of goods manufactured by it, and will have present during the exhibition two or three of its most competent salesmen, including Mr. Thomas L. Townsend, to meet its many friends who visit the exhibition. It is also the intention of the firm to be at the exposition as much as they can conveniently do so.

DIAMOND ELECTRIC COMPANY, CHICAGO.

Transformers, Watt meters for house service, operating on 2, 4, 6 and 16 candle-power lamps, will be the exhibit of the Diamond Company. The exhibit of their Scheeffer transformers will be the feature of the show.

FT. WAYNE ELECTRIC CORPORATION.

This company will display four single-phase motors, one rotary transformer and one direct-current, direct-connected, 25 K. W. machine. Mr. Adams, the company's New York representative, will have charge of the exhibit.

Roentgen Science to Date.

In another part of this issue we reproduce a Rœntgen picture of the corpse of a marasmic child, and a short paper by Drs. Morton and Chapin on the subject. We acknowledge credit to the New York *Medical Journal* for the photograph and the article.

THE ELECTRICAL JOURNAL has been more than conservative in this matter of the Rœntgen science, largely because we were quite sure that there would be plenty of time for calm, deliberate work and real research after the notoriety seekers had been driven from the field. We say again what we stated before that Mr. Edison stands alone as the one man on this side of the water to actually improve on or add to what Professor Rœntgen had already achieved. Others have merely followed, or even exploited sensational fallacies.

As appears from Dr. Morton's work, and that of others, the time has now come for men who are willing to plod, to take the field and evolve, out of all the recent history making past, something that will be of service to the world. We have never felt that Professor Rœntgen had discovered any principle likely to solve the science of medicine and surgery or to light up all the dark places. But we have been impressed from the first with the probability that he had done as much for humanity as the designers or inventors of the ophthalmoscope, stethescope, speculum, largyngoscope, cystoscope, the pulse wave as indicated by the sphygmograph, and the varied mechanisms that have done so much to bring the special branches of the medical science to their present high state of perfection.

There will hardly be much new matter offered on this subject. The scientists will delve into the mysteries of all sorts of semi-occult lore and learning, but the practical men like Edison and W. J. Morton will improve on, and apply the original thought, and perfect the apparatus employed. It is not quite certain yet, at least, it has not been demonstrated that the Rœntgen rays can be made to materially aid diagnosis in or about soft tissues—such as the nature of tumors, or the character of effusions, or the presence or location of pus sacs, such typhlitic or peri-typhlitic abscess, or abscess of the liver. Those points many be settled hereafter by the improvement of apparatus.

It is very certain that surgery, at least bone surgery, is to be almost revolutionized by the new aid to accurate diagnosis. There are two points that will merit the best attention—first, to take useful pictures in a short time; second, to get a wider range of shading where soft tissues are concerned.

Try It On The Dog.

Some time ago, George D. Burton made the startling claim that electricity would not kill. We received the news with some slight reservation, but we agreed to believe George if he would tackle the business end of a couple of wires we could dish up for him and then reiterate his claim. We urged that the second claim, under the circumstances would be entitled to consideration. Now comes Dr. H. P. Pratt and claims to be able to kill all the bugs and bacilli that epidemically or sporadically infect helpless humanity. We are still conservative and are ourselves afflicted with the bacilli of unbelief. If Dr. Pratt will let us unleash within the confines of his person a pack of deep-chested bacilli that we can produce, and then stay with us to enjoy the "sensation," we could forgive him for the mighty upheaval he has caused in the scientific world. And we pledge ourselves not to question his "motives" or his scientific attainments again.

Fooling the People.

The genial Dr. Depew did not live near P. T. Barnum for years without imbibing some of the great showman's shrewdness in advertising himself. The Depew plan to telegraph a sentence or epigram of some sort around the globe over a single circuit shows this. Now if the Doctor will let the wording go to the highest bidder for cash, and donate the amount to some good charity, such as the Morton Presidential boom, he will turn several tricks at one time. We are surprised that Dr. Depew had not thought of this, but—"two heads," etc.

If you want to see a panic, just let some one claim that the X-ray can disclose the actual paid circulation of some of our distinguished contemporaries. Whew, how there would be a rustle for a good insulator!

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PRATT'S WORLD'S FAIR AWARD.

While Dr. H. P. Pratt could hardly be better pleased in any way than by having the newspapers and press generally discuss him and his affairs, and however little entitled to consideration he may be on his own merits, in his threat to bring suit against the World's Fair Bureau of Awards in general, and Dr. W. J. Herdman, one of the judges, in particular, he has opened up an affair that seems to me to warrant an expression from me personally on behalf of the Department of Electricity, in which I had the honor to serve.

Because I happened to be a graduate in medicine, and was supposed to be familiar with medical matters Mr. Barrett, Chief of the Department, was good enough to defer to me in the matter of the admission of electro-therapeutic apparatus as exhibits. I had been, and was, at the time, as violently opposed to electric belts, brushes breezes and baths, as the most extreme of my fellows in the old school of medicine, and I am still opposed, with no less violence, to the handling of electricty for electro-therapeutic purposes, by any one, not a capable physician. There were a dozen concerns in this country, however, which made and sold electro-therapeutic "appliances," from which an actual electric current could be obtained. I regarded, and do still regard these concerns as dangerous to the public.

Their applications for space in the department were made in good faith, conformed in every way with the requirements of the department, and could be refused by the chief on the sole ground of want of space. At an early date in the assignment of space, far more than was available was applied for, but owing to the then approaching hard times, which seemed to catch the electrical interests first, much space was thrown back on the hands of the chief, whose greatest concern it then was how to fill it. These electro-therapeutic appliance people were exerting all the pressure they could command to get in, and, finally, appeared before the chief with a petition signed almost unanimously by the other exhibitors, asking that they be given a chance to appear before the judges. After careful discussion of the matter with the director-general and the other authorities, we concluded to allow them in, and so notified Dr. Herdman, Chairman of the Sub-Committee on Awards, which would have to pass on such exhibits, also Professor Henry S. Carhart, President of the Board. I knew Dr. Herdman to be more opposed to quackery than almost any one, and I had his assurance that the exhibits would be examined and reported on. I thought I knew what that meant. Dr. Herdman did examine the exhibits, and he did report on them, and up to that time our plan had gone well. But there happened to be on the jury Professors Forbes and Ayrton, English members, who opposed the whole matter, urging that in the event of Dr. Herdman's committee deciding to condemn the appliances, no report of condemnation could be written from which these people could not extract enough commendatory language to be used as an endorsement in their advertisements. Their opposition grew out of some bitter experience of their own, and that of Prof. Sylvanus P. Thompson in London. Dr. Herdman's report was then before the board, and it was moved to table the whole matter, leaving these people in the department as exhibitors, and leaving them in the attitude of being there with the sanction of the department. I wrote a very emphatic letter to the board of judges, now on file among their papers, and a copy being in the Field Columbian Museum among the papers of the electrical department. I branded the action of the judges as being cowardly in the extreme, and demanded in the name of the Exposition and the medical profession that they come out frankly and let the condemnation of all quackery be made known to the world in detail, giving names and appliances. I insisted that the board was shirking its gravest duty, if its members did not take such action, especially as electricity was then forging to the front as a legitimate remedial agent in the hands of the medical profession, and the people had a right to an expression from the board indicating what was legitimate and what was quackery.

My point was lost; I was beaten by the timid members, and I have been told repeatedly since, by some of the judges, that they were not fully advised in the matter at the time, or else they would have supported my position. Dr. Herdman's report was sup-

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pressed, and I was left in the attitude of having admitted exhibits that were frowned on by the board of judges.

It was arrant cowardice, and did more to keep back the progress of electricity in medicine and surgery than these quacks themselves had done by their charlatanism.

Dr. H. P. Pratt was one of those exhibitors. Dr. A. Owen, the electric belt man, with the long beard, was another. This is how near Dr. Pratt came to getting an award, and this is the story of his grievance.

J. Allan Hornsby

Van Depoele.

Elsewhere in this issue we publish a biography of Charles J. Van Depoele, whose name and work have been recently so prominently before the country in connection with the General Electric Railway patents. In sustaining the integrity of one of these patents, Judge Coxe of the United States Court recently paid this high tribute to Van Depolele's work:

"Although the electric road of to-day is a composite organization to which many ingenious and able men have contributed, yet it cannot be denied that to Van Depoele, more than to any other man, belongs the credit of having made it a practical working success. His contributions to the art rapidly supplanted the crude and tentative prior structures and have continued in use until the present time. No one can read this record without being impressed with the truth of this proposition, and this being so the court naturally approaches this controversy in liberal spirit and with an inclination to give the inventor the full fruits of his invention."

We may only add a bit of history concerning Van Depoele, that may be of interest. In 1891 when the World's Fair authorities were deciding upon the names of great electricians to adorn the Electricity Building several lists were made by individuals for submission to a committee meeting. Van Depolele's name was on every list. It was subsequently determined to use only the names of men already outside the field of action—that is dead. Hence Van Depoele's name was taken from the list, but before the building was done Van Depoele was eligible under the rule, but all the places were filled.

The *Electrical Engineer* (London) comments on the efforts of the Amsterdam authorities to obtain the municipal ownership of the telephone business as follows:

"According to the British consular reports, the authorities at Amsterdam have been for some time anxious to put in force a policy of municipalization so far as concerns the undertakings of public supply companies. It appears from the same source that the Amsterdam Telephone Company, to which at first very unsatisfactory terms were offered for the purchase of their installations on the expiration of their concession, eventually succeeded in obtaining acceptable terms for the transfer of their business to the municipality, but the attention of investors is called to the risks run by companies based on municipal concessions."

There should be no reasonable doubt that the Hollanders can make as much of a success of the telephone business as Superintendent Sir William Henry Preece has done—at least they could not possibly do worse. But would it not be desirable for the Amsterdammers to come over and see our service before they "leap?"

Pratt's Publicity and Promotion Bureau.

Dr. Harry P. Pratt has, according to the Chicago *Tribune*, forsaken for the time being his deadly onslaught on bacilli to bring suit for damages to his character against THE ELECTRICAL JOURNAL, and against the world's Fair Committee on Awards for not granting him a diploma.

In the last issue THE ELECTRICAL JOURNAL suggested the entire unlikehood of Dr. H. P. Pratt doing anything for science or the world at large. THE ELECTRICAL JOURNAL repeats the suggestion, and adds that men who are really doing scientific work do not usually maintain a newspaper bureau as a part of their equipment. Dr. Pratt has no more idea of bringing suit against THE ELECTRICAL JOURNAL than he has of bringing one against the World's Fair Bureau of Awards, and if he brings either it will be yet another grand stand play for notoriety.

FRANK B. RAE.

The subject of this sketch is best known for his invention of the Rae Motor and his system of street railway equipment. As the engineer in charge of the Detroit Electrical Works he equipped about 30 roads. Prior to that connection he spent a year in China (1887) for the Barker-MetKeiwitz syndicate. His latest work is the Standard Electric Elevator, recently bought by the Standard Elevator Company, of which Ex-Mayor John A. Roche is president.

Like many or most of the Electrical fraternity Mr. Rae began in the telegraph business. His first service was with the Western Union Company in charge of their Syracuse offices. In 1873 he was sent to New York City as chief operator, where he remained until in 1877 he was made chief electrician of the San Francisco offices. It was under his direction that the overland quadruplex was instituted between Chicago and San Francisco. It was in 1880 that he forsook his first love and became interested in lighting and railway work, so that he is one of the pioneers in those fields. In 1880 he became electrician for the Brush Electric Company and for them built the San Jose lighting station. In 1884 he constructed the electric railway that was on exhibition in the Old Exposition Building in Chicago. In 1884 he went back again to his "old chickabiddie," the telegraph business, and became assistant to S. D. Field in the Commercial Cable Company. Since 1891 Mr. Rae has confined himself to engineering work, mostly in the direction of light and power. He is consulting electrician to a number of cities and towns and is fast growing into the favor of those who believe that good work in electrical installation will be like bread cast upon the waters.

Frank Rae is one of those fellows everybody with a liking for big, broad men must admire. He is game clear to the core. If things come his way he assumes naturally that he is entitled to the gifts of Fortune and takes what the fickle goddess sends with becoming modesty—but he takes it all. When, on the other hand, a big storm comes up, like a good sailor he reefs his sails, gets close up to the wind and takes what comes without an extra heart beat. Consequently there are more warm friends who are glad when Frank Rae is glad than most men can boast of. Mr. Rae has a delightful family and the sunshine he brings into his daily business he undoubtedly casts from his home every morning.

May he and his long be the Roentgen Raes of society to light up dark places and shed lustre where the commoner rays of light are not able to penetrate.

BADLY SCARED FIREMEN.

During the big storm of the night of the 23d in Chicago the power station of the Consumers' Electric Light Company, at 302 Blue Island avenue, was struck by lightning. Only about $50 of damage was done, but the nerves of several firemen were badly bruised and shattered. They were not aware that the machinery had been shut down hours before, and that there were no "deadly currents" lying around loose. Consequently they handled things pretty gingerly, expecting every moment to be yanked into the fireman's heaven.

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GALVANOMETERS AND GIRLS

"Jiggers" Expose the Mysteries of Maidenly Attire and Bring Trials and Troubles Upon California "Co-Eds."

MUST GIVE UP CORSETS OR ELECTRICITY

A new reason why the new woman must discard one of the most characteristically feminine articles of her attire or fall short of filling her role has turned up at the Girls' High School at Oakland, Cal. She must either abandon corsets or one of the most promising of the professions, that embracing electricity in all its branches. Five hundred Oakland co-eds are seriously disturbed over the situation, but the issue is severely plain. One or the other must be abandoned, the governors of the school say.

An electrical department was added to the school some time ago, and a course in electricity established. The poor professor in charge has had a dreadful time. During the lessons the delicate instruments have played him all sorts of tricks, and all his experiments have been of doubtful success. Every once in a while a girl would step up to tell what she had learned about volts, ohms and amperes, and immediately the galvanometers would gyrate wildly and the needless on the various dials would wabble, and all the laws of Volts and Ohm and Faraday would go to smash, and the findings of Edison and Tesla would become strangely lost. Then the professor knew the student beside him had on a high-grade corset with ribs of finest steel. The instruments were not affected by the presence of some students because they wore health waists of some sort and were braced with whalebone or some substitute for steel.

The professor made poor progress with his class. It was impossible to make accurate experiments before some girls and among these were the most promising girls in the class. Something had to be done; but the professor, being a man, felt a natural delicacy about doing anything. Two of the women teachers tackled the girls on hygien ande physical development, and warned them of the evils of corsets. But, the real motive of the new crusade leaked out, and at present there is much perturbation among the ambitious co-eds, who are anxious for scientific attainments, but yet have all the hundred reasons a woman can advance for not discarding the corset.

"This corset trouble is of long standing," Professor Meads of the electrical department told an *Examiner* reporter. "The machines in the electrical department are delicately constructed, and they are so much affected by the near presence of steel or iron that it is utterly mpossible to secure accurate results in experiments. I have been compelled to have the physical culture teacher explain to the girls that they must discard their corsets before they take their lessons in the electrical department. I can tell at once by the jumping of the needles that a girl is wearing corsets. It is simply a question of having the girls recite their lessons properly, and they cannot do so wearing corsets."

Finally Professor Meads was obliged to issue a rule barring corseted girls from the electrical department, and the governors indorsed the rule. It might seem to be a rule difficult to enforce and delicate to handle. But Professor Meads finds it easy. In entering the electrical department the girls have to pass one of the professor's sensitive galvanometers. The professor stands unobtrusively by it. The impertinent "jigger" works like a charm, and there is no way in which the girls can beat the game. On the near approach of a girl wearing steel-ribbed corsets the needle gyrates frantically, and the girl is respectfully but firmly reminded of the rule, and expostulations are useless. Just how the incident will end cannot yet be told, but the faculty hope the girls will take the advice fo Dr. Knox and Dr. Shuey, both women professors, and abandon corsets on general principles.

In urging the reform Dr. Shuey paid a high compliment to Eastern young women in some remarks calculated to put the Pacific Coast girls on their mettle. After an extensive trip through the East, visiting many prominent gymnasiums, she said, she was impressed with the fine bearing of the Eastern girls as compared with the California girls. She concedes that California girls are just as richly endowed by nature as the Eastern girls, but they have had but little gymnastic training.

Even gallant Chauncey M. Depew told a California interviewer the other day that he did not think very much of the California girls he had seen during his recent trip through the State. He diplomatically added that his opinion was perhaps formed from limited opportunities of observation, and he doubted not that if he had the time to see California's social side he would find lots of very beautiful women there. But, while speaking most highly of all California's well-advertised attractions of scenery and climate, he deplored the absence of song birds and beautiful women.

LEAVES BACILLI FOR BIGGER GAME.

Weary of slaying helpless bacilli with an X-ray, Dr. Harry P. Pratt has turned his attention to bigger game and is now hot on the trail of the members of the World's Fair Committee on Awards. The doctor and those associated with him in the School of Electro Therapeutics feel they were robbed of an award by the committeemen and are going to take the matter into court.

"In due time," said Dr. Pratt yesterday, "we will begin suit against certain of the committeemen. The papers are being prepared as quickly as possible."

Dr. Pratt admitted he was on the trail of THE ELECTRICAL JOURNAL, and would probably sue the publisher for damages.

"I have spent $150,000 in my electrical scientific experiments," he said, "and am not a greenhorn, by any means. In scientific electrical researches I will not play second fiddle to any man."

And the doctor began to discuss Tesla and Edison. He said the account printed in the *Tribune* had pleased him greatly, though he was by nature opposed to publicity, and that many of the doctors who denied knowing him were well acquainted.

"I am working in the hope of being able to kill the bacilli in the human body," said he, "though I have not yet accomplished that. I expect when I succeed in killing bacilli with the X-ray to reduce the death rate 50 per cent."—*Chicago Tribune*, April 24th.

PROPOSALS.

FOR

Compressed Air and Electrical Equipment North Halsted Street Bridge.

Sealed proposals will be received by the city of Chicago until 11 A. M. Monday, May 11th, 1896, for the construction and installation of the compressed air and electrical equipment for the new rolling bascule bridge over the North Branch of the Chicago River at North Halsted street, in the city of Chicago, Ill., according to plans and specifications on file in the office of the department of public works of said city.

NOTE.—An emergency appropriation of twenty-five thousand ($25,000) dollars has been made, out of which the cost of the above-mentioned work will be paid.

Proposals must be made out upon blanks furnished at said office, and be addressed to said department indorsed "Proposals for Compressed Air and Electrical Eqiupment for North Halsted Street Bridge," and be accompanied with one thousand ($1,000) dollars in cash or a certified check for the same amount on some responsible bank doing business in the city of Chicago and made payable to the order of the commissioner of public works.

The commissioner of public works reserves the right to reject any or all bids.

No proposal will be considered unless the party offering it shall furnish evidence satisfactory to the commissioner of public works of his ability, and that he has the necessary facilities together with sufficient pecuniary resources to fulfill the conditions of the contract and specifications provided such contract should be awarded to him.

Companies or firms bidding will give the individual names as well as the name of the firm with their address.

W. D. KENT,
Coomissioner of Public Works.

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NEW VACUUM TUBE LIGHTING

Some Recent Developments in the Direction of Artistic and Utilitarian Service, Private and Public.

INTERESTING AMERICAN INSTITUTE PAPER

Most people have been accustomed to oil lamps, gas jets and other forms of light which have about reached their perfection. With the appearance of the arc and incandescent lamps it was thought that electricity had reached its limit in giving to the world a system of illumination that would leave nothing more to be desired. Indeed, it seems almost a presumption to dare to think of light being produced that would approach daylight in form and quality. The time is not so very remote when any man, who would have attempted to manufacture sunshine, would have shared the fate of a Galileo.

But unfortunately the investigator of to-day has nothing of this kind to fear. Much arduous labor has already been expended in the solution of the problem by many eminent electrical scientists engaged in the study of vacuum tube phenomena, but the results from a practical point of view have been very meagre. This is chiefly owing to the complicated and expensive apparatus necessary, and the very unsatisfactory results even then obtainable. In fact, light from vacuum tubes, which is the only form of illumination that actually approaches nature's standard—daylight, has never been obtained in any quantity that would, in any way, be suitable for practical use. Of the other forms of electric lighting, the incandescent lamp is the most prominent. It is the peer of all illuminants in commercial use to-day, but is lacking, when we consider maximum uniformity in the distribution of light, and when calculations show that only three-tenths of one per cent. of the energy of the coal necessary to produce light by incandescence (its name defines its character) is actually transformed into light, it is evident that

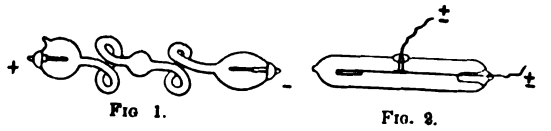

Fig 1.

Fig. 2.

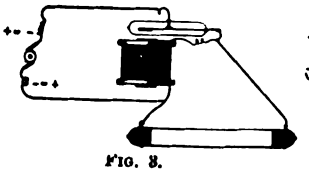

Fig. 3.

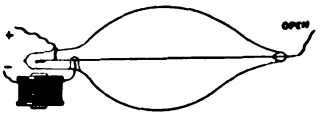

Fig 4.

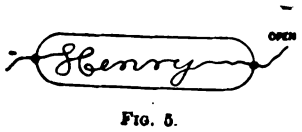

Fig. 5.

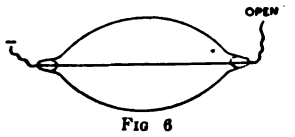

Fig 6

there is room for improvement. The new electric light should possess all the good qualities of the present lamp with none of its drawbacks, and among its improvements will be noted the combination of utility and decoration. The recognized tendency of the day is towards multiplication of lights and avoidance of strong shadows—in other words, an even illumination—that is, light from all directions.

The object of this paper is not only to call attention to the advantages that will accrue with the adoption of vacuum tube lighting, but more particularly to a simple method of obtaining a current which will ultimately make such an adoption universally feasible. Almost without exception, experimenters in vacuum tube lighting have hitherto sought for the solution of the problem by merely pushing to extreme well-established methods based on principles long known in the art. That is, strictly speaking, no radical departures from the well-beaten paths have been as yet brought forward. However, this paper does represent radical departures—in principles, in apparatus and in the nature of the current, resulting in a light of greatly increased intensity.

Before entering upon a description of the new system, permit me to call your attention to the methods heretofore used for obtaining light from hermetically sealed glass tubes containing a rarefied gas.

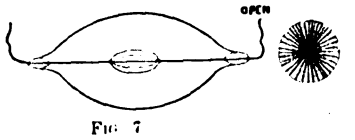

Fig. 7

Fig 8

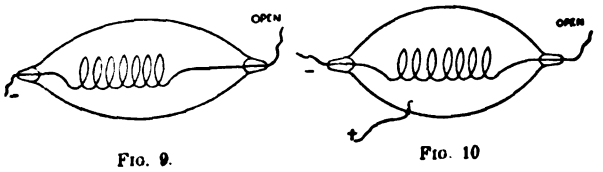

Fig. 9.

Fig. 10

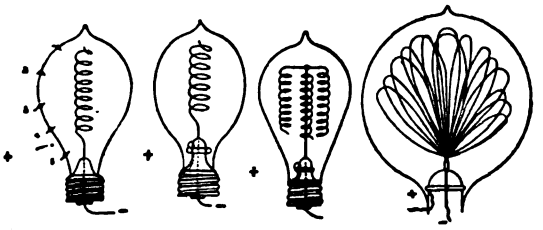

Fig. 11. Fig. 12. Fig. 13. Fig. 14.

For many years the Geissler tube has been a scientific toy. When a suitable electric current is connected to its terminals, its entire length is filled with a faint glow. This is, of course, a light of radically different character from that now used in any commercial form of illumination. (See Fig. 1.)

It is light emanating from rarefied air with an apparent absence of heat and combustion. Upon this principle developed, probably depends the light of the future, which will soon be, in the opinion of the writer, the "light of the present." As a device for transforming electrical energy into light, the vacuum tube is very efficient. The majority of authorities place it at about 70 per cent., and the incandescent lamp at 2 per cent. Notwithstanding this remarkable efficiency, it has never been commercially possible to illuminate by vacuum tube, because the light could not be made sufficiently intense (this is expressing it mildly) even with bulky apparatus that was entirely impracticable.

Furthermore, the current produced by such apparatus was of such a nature as to render its insulation extremely difficult. The ordinary induction coil is often used for this purpose. A current of low voltage, such as that from a battery of a few cells must be used with such a coil, because a current of higher voltage could not be properly disrupted, the arc forming, preventing a sudden break of the current. But since the light depends on the suddenness of the break, the arc must be prevented, therefore the quicker the break, the brighter the light—provided the apparatus is properly designed.

The quickest break can be made by interposing in a circuit the most perfect dielectric in the minimum space of time. The best dielectric known is a vacuum, and I have discoevered methods for interposing it in rapid succession in a current in a minimum space of time, depending upon the principle of making and breaking a current rapidly in a vacuum.

The disruption of any current in the air results in the formation of a spark of greater or less length, and the greater its length, the less sudden the break. Therefore, if the break be made in a vacuum, the narrowest conceivable complete gap in the metallic conductor results in an almost instantaneous discontinuance of current, ensuring a maximum C. E. M. F. The current is thus interrupted in an almost infinitely short space of time as compared with all the ingenious mechanical contrivances, such as air-blasts and magnetic blow outs devised for the purpose of breaking a current suddenly in the

A paper read by D. McFarlan Moore, at the 105th meeting of the American Institute of the Electrical Engineers, New York. April 22, 1896.

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open air, but all of which are of little avail for the production of any quantity of light.

The vacuum vibrator, as shown in Fig. 2, is the nucleus of my invention. Although an exceedingly small device (not as large as one's finger) it demonstrates when in circuit with a small magnet (not as large as a teacup), a principle embodying great possibilities. It is a new piece of apparatus, exemplifying a principle of value not only applicable in practical use, but also an improved implement for scientific investigation.

It is almost unnecessary to describe such a simple piece of apparatus, which consists merely of a spring rigidly supported at one end, and having attached to its free end a small disk of soft iron. A contact point rests against the spring at about its centre. A sealed glass tube, from which the air is exhausted, encloses both spring and contact point. The system, as a whole, is exceedingly simple. An electric current passes through a coil of wire and then through the vacuum vibrator. Wires in contact with the outside of each of the ends of a closed and empty glass tube are attached to the two ends of the coil of wire. This statement embodies the gist of the invention. (Fig. 3.) It will be noticed that this system is far simpler than the apparatus ordinarily used to excite Geissler tubes. The secondary coil is absent, reducing the expense and bulk many fold, as are also the metallic terminals sealed into the ends of the Geissler tube, but it produces light, the desideratum, in wonderfully increased volume.

With this apparatus, currents of almost any voltage can be rapidly and suddenly interrupted, and it is, therefore, now possible to obtain, by using ordinary commercial currents, strong light in vacuum tubes.

When the circuit through the magnet and vibrator is closed, the armature within the vacuum vibrates rapidly, disrupting the current within the vacuum at each vibration.

The resulting high-tension current excites a brilliant luminosity in another tube, usually of much larger dimensions, and containing a lower vacuum than the vibrator tube. There is, therefore, a necessity for two vacuums, one the very highest, the other very low. However, I have tried a number of experiments, using but one vacuum, practically amounting to an enlargement of the vibrator tube and a lowering of its vacuum. (See Fig. 4.)

This is manifestly not a good plan for the production of light, because the breaking of the current does not occur in a high vacuum, but it led to an interesting line of experiments, the most novel of which will now be brought to your attention.

Within this low vacuum is placed a wire which can be sent and shaped into any form desired, as shown in Fig. 5. When connected to the vibrator, the beautiful effect is immediately apparent, the wire being enveloped in a delicate purple glow. This can be applied to various purposes, such as advertising. One wire only connects this sign tube to the vibrator, and it is attached to the armature terminal of the vibrator, because when so connected, it is the one which receives the high potential discharge of the magnet. In the bulb now shown (Fig. 6), the vacuum is higher, and a single wire extends through the centre. The light, instead of appearing as a purple envelope around the wire, now fills the entire chamber with a beautiful milky glow.

Close inspection, however, reveals the fact that there is a very small dark space immediately encircling the wire, and beyond it there appear to be rapidly moving rings of light, concentric with it. In fact, one is reminded of the field of force surrounding a conductor, as displayed by the familiar arrangement of iron filings—indeed, it is a similar phenomenon—the molecules of the residual gas taking the place of the iron filings.

The next bulb (Fig. 7) is similar to the one last shown, but with one exception. The wire is not single throughout its entire length; for a space of about three inches at its centre it separates into six strands, which thereby form a kind of cylindrical cage about one-half inch in diameter. In this case the entire bulb is not filled with a glow, but the interior of the cylinder forms a pencil of light quite dense, denoting that a new principle is brought into play. It is this —every current creates its own electrostatic field around its conductor, which, when immersed in a gas at the proper degree of refraction, causes it to give forth light, which is most dense in a comparatively small circle surrounding the conductor. (See Fig. 8.)

When two wires, each having its field of force, are placed parallel to each other and about one-half inch apart, the density of the field between them will be doubled, and consequently the light in almost the same proportion. It will thus be clear that the pencil of light is due to the intersecting or overlapping of the fields of force of each of the six strands forming the cage. Upon this new principle many interesting lamps have been constructed, the problem being to get a maximum number of fields of force to intersect. Probably the best solution is in a cylinder made by spirally winding a wire, as in Fig. 9, causing its field to intersect in a manner that is almost ideal. This explanation may seem at variance with Faraday's famous experiment, proving that an electrostatic charge does not reside in the interior of the charged body. The vacuum may make the difference.

In this bulb (Fig. 10) there are two separate terminals projecting from the glass. When the spiral is connected to the negative pole of the vibrator, and the other terminal is made positive, the light is greatly increased. Such a lamp can be very conveniently made by using an incandescent lamp bulb, as in Fig. 11. The bit of platinum wire extending into the bulb and forming the positive pole, can be placed in any of the positions 1, 2, 3, 4, 5, without affecting

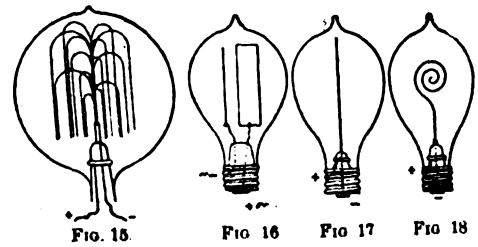

Fig. 15 Fig 16 Fig 17 Fig 18

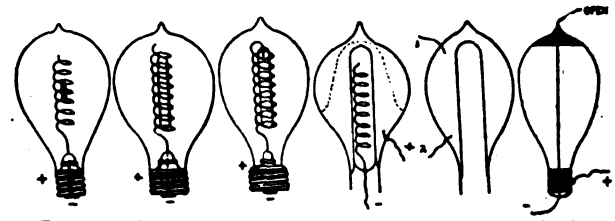

Fig. 19. Fig 20. Fig. 21. Fig. 22. Fig. 23. Fig. 24.

the light in the spiral, but it is apt to become heated, and this is remedied by attaching to it a metal wire ring. (See Fig. 12.)

In these lamps a large proportion of the light is confined within the spiral, and since volume is desirable, the idea of increasing the number of spirals suggests itself, as in Fig. 13. But the total volume of light emitted by four spirals is only equal to that of a single spiral lamp—that is, each pencil is but one-fourth as bright; hence, to bring them all to full brightness, the energy of the inductive current should be increased in proportion.

With the idea of obtaining from the entire bulb a uniform glow, the lamp shown in Fig. 14 was constructed. The "filament" consists of a great many complete loops of very fine aluminum wire. Fine wire was used, not only because of appearance and weight, but also for two other seasons: First, because a fine wire has about as large a field of force as a much larger wire; and, second, because it does not obstruct the light so much, and at the same time is a minimum of metal within the vacuum. This is a matter of much importance, as upon it largely depends the life of the lamp. A great many different conductors were used for the construction of these filaments, the main idea being to use that material which contained the least occluded gas, and would be disintegrated a minimum by the action of the current. Fig. 15 shows ordinary incandescent lamp filaments utilized in a glow lamp, but one leg only is cemented at the centre of the bulb to the negative terminal, the other being free—a veritable fountain of filaments. A rather curious and not entirely explained phenomenon was noticed in this form of lamp—namely, the free ends of the filaments were apt to be violently agitated, and whenever they touched the glass of the bulb, they heated up to a bright red throughout their entire length, producing a most brilliant combination glow and incandescent light. Many are the

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advantages of these lamps over those using fluorescent materials, as the sulphide of zinc or calcium. Sometimes when the exhaustion is carried a little too far, the vibrator current is unable to affect the lamps, but after they are held in contact with one pole of a large induction coil for a few moments, and then connected to the vibrator current the trouble ceases.

In all of these forms of lamps it is very interesting to note that in order to get manixmum light, the subdivided terminal of the lamp must be so connected to the mains that it is negative. This is interesting to remember when the subject of lighting tubes is considered.

The class of lamps will now be considered where, instead of subdividing the lighting electrode into filaments, plane surfaces are used.

The bulb in Fig. 16 contains two pieces of sheet aluminium equal in size, set with their planes at right angles to each other, in order that a minimum of light may be interrupted from any point of view, and that the positive will act as a reflector to the negative. These pieces of aluminium must be carefully cleaned before being placed in the lamp, because any grease upon them will cause beautiful tufts of light all over their surfaces, instead of a glow filling the bulb, and the vacuum will soon be lost. Of course, in a lamp of this construction the poles can be changed with impunity, and if an alternating current be passed through the vibrator, both plates will give light, but the total amount will be the same as when direct current is used.

One of the many modifications of this form of lamp was to make the magnetic pole in the form of a small cylinder of aluminium gauze.

Many lamps were made on the principle of a spiral within a spiral, wound in the same or opposite directions, and also of using metallic coatings on the tubes interior and exterior, as well as using bulbs of all shapes and sizes. One important advantage to be noticed in all these forms of lamps is the total absence of the very objectionable striations, such as occur in the ordinary Geissler tube.

Fig. 17 is a very simple form of lamp—merely a single piece of straight carbon filament producing the light.

Fig. 18 is another of peculiar form—an unusual density of white light inside the convolutions of the spiral.

To determine whether there was any appreciable heat at the centre of an intense pencil of light, a number of lamps were constructed in which various substances were placed at the point of greatest density of light, as in Fig. 19, but in no instance was the substance affected in any degree whatever.

Following out this idea a little further, there was inserted a small glass tube containing air properly rarefied in the centre of a spiral, as in Fig. 20.

But the inside of the small tube remained dark; nevertheless, the glow outside of the spiral, dark space and other phenomena, even to the tufts of light between some of the convolutions of the spiral are the same as those in a similar lamp without a tube, inside its spiral.

Another lamp was then made the same as the last, except the tube inside the spiral has a platinum wire extending into it, which wire is electrically connected with the spiral (Fig. 21). Of course, the small tube was tried separately before being placed in the lamp bulb, and it filled with a white glow. But after the lamp was completed it refused to give any light; the glow outside the spiral, however, was the same as though there was no inner tube present.

Hoping to get a lamp with almost no metal in the light-producing vacuum, the lamp shown in Fig. 22 was constructed—the spiral is within a separate tube. When tried, a tuft of light appeared in the top and bottom of the small tube which was surrounded by a faint glow, the outlines of which are shown by the dotted line.

The next step was to do away with the inner vacuum and construct a bulb as shown in Fig. 23. When a spiral was inserted in the tube and connected to the negative pole, the positive being either 1 or 2, a dark space an eighth of an inch deep surrounds the tube, beyond which a faint pinkish glow appeared filling the bulb. The phenomena known as "afterglow," which is sometimes noticed in evacuated bulbs after having been subjected to an electrostatic strain, I have been able to obtain, but very seldom. (Fig. 24.) However, this bulb could be picked up and carried around the room, but every time it was picked up after being laid down, a discharge resulted, which, being repeated three or four times, dissipated the glow entirely.

From a tube containing two parallel wires, shown in Fig. 25, but with a low degree of exhaustion, the glow was entirely absent, but instead, brilliant, flaming yellow discharges completely filled the space between the wires, which was over half an inch wide and about two feet long.

At the beginning of the lecture your attention was called to the great similarity existing between the field of force of a "cold-light" giving conductor in a partial vacuum, and that of a conductor conveying a current in the open air. Care, however, should be taken to note that the light from the rarefied atmosphere is due to electrostatic and not electromagnetic phenomena.

For example, I have here a poweful electro-magnet which I connect directly across the lighting mains, and, therefore, it is one at whose centre or core the electro-magnetic field is very dense. When this tube, which has a diameter the same as that of the core of the

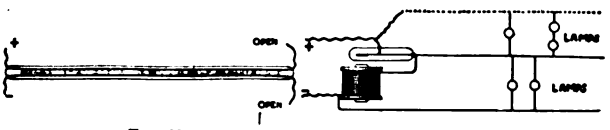

Fig. 25 Fig 26.

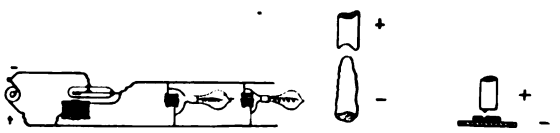

Fig. 27. Fig. 28.—Electric Light Carbon. Vibrator Contact Points

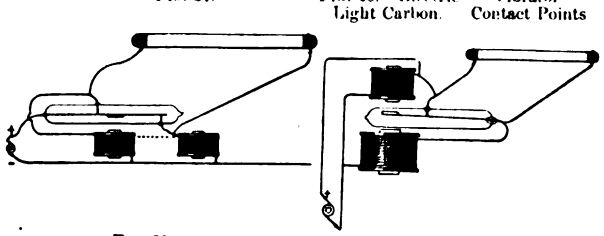

Fig. 29. Fig. 30.

magnet, has about half of its length passed through the centre of the magnet, no light whatever results. If, however, but one terminal (the other being free) of this same magnet be connected to the vibrator, immediately the tube gives forth light.

Referring again to the subject of connections, Fig. 26 shows the light connected around the terminals of the magnet; it also can be connected with equal results around the break or spark gap as shown by the dotted lines. Your attention is called to the fact that lamps of this kind will operate equally well, whether connected in multiple or in series, provided the area of the negative electrode is about the same in each; if not, that one in which the negative electrode is of greatest area will alone light up.

If a single bulb of small size be connected to a circuit of considerable induction, a well-defined discharge is liable to occur which will ruin the lamp.

In Fig. 27 a inductive resistance is distributed with each lamp, making the system of distribution self-regulating—that is, the turning on or off of lamps will not affect the brilliancy of those burning steadily.

Referring again to the diagram of circuits showing the system in its simplest form: If good results are to be obtained, the magnet must be designed and constructed with the greatest care. Its duties are two fold; first, to give the vibrator its mechanical motion; and, second, to act as an inductive resistance. The iron core must be proportioned to the conditions of the circuit. If there be too much or too little, the light suffers, but a certain amount of iron should remain, in order that the magnet have sufficient power to vibrate the armature. Similarly if there be too many or too few turns of wire on the magnet, the light is decreased. From this it is evident that vibrators of different rates will not be suitable to the same magnet. However, even when a vibrator is connected to a suitable magnet and circuit, and produces a good light, it can be

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further improved by "turning the circuit"—that is, altering its self-induction by varying the amount of iron in the magnet's core. It should also be stated that by this means a maximum light is obtained from a minimum current. In order that the time constant of the magnet be a minimum, and to ensure rapid action, the magnets should be short and thick. Large induction coils cause the tubes or lamps to give forth but little light, while a small magnet, whose length of wire is not one one hundredth that of the induction coil, will cause the tubes and lamps to light up brilliantly.

It is interesting to note that with a comparatively few turns of wire a very small one-volt battery will give quite a strong glow. This glow can be intensified by using a secondary coil.

Although the various lamps that have been described are of great interest, nevertheless the very nature of lighting by luminescent gas is such, that it is far more applicable to radiate from sources of considerable area than from units of light of small area. The best method of obtaining light from a large area is by the utilization of tubes of considerable length, instead of small bulbs. The light of thesetubes should be entirely free from the very objectionable striations always present when interior electrodes are used; but these striations are entirely obviated by using exterior electrodes. They may be metal caps on the outside of the tube, or preferably merely coatings of metallic paint. Such tubes can be made up in almost any lengths, and can be bent into a great variety of forms, making them suitable for exquisite decorative effects. Under this head can be mentioned the fashioning of tubes in the form of letters, which may be used as electric signs.

Permit me to callyour attention once more to the key of the whole system—namely, repeated interruptions of an electric current in a high vacuum.

The simplest method of accomplishing this object is to hermetically seal within a glass tube a vibrator of ordinary form, but its exact construction to give the best results has been a matter of tedious experimentation and study. The very slightest alteration in the dimensions of almost any of its parts—such as the length, width and thickness of the spring, or its method of mounting, or the position of the contact points, or the thickness or diameter of the armature, will cause it to be a very good, or a very poor vibrator. Again, the operations of the glassblower had to be watched most carefully. Only certain kinds of iron and steel were selected, to avoid occluded gases, and even then they must undergo a special treatment before being fit for use. The selection of suitable contact points has also been a large field for research. Nearly all kown conductors have been tried, and many interesting facts have developed in this connection, not only so far as the direct action on the various metals in vacua and various gases is concerned (and this in several instances is the reverse of the phenomena noted in open air), but also with reference to the electro deposition or electrolytic action that takes place. For instance, as is well known, the positive electrode is the one which disintegrates most rapidly in the open air, and its apex is usually concave. This is probably best shown in the ordinary direct current arc lamps. If aluminium or any soft metal of comparatively low fusing point be used as contacts in a vibrator, after about a day's run, an examination shows that the shape and condition of the contacts is just the reverse of the way they appear after use in the open air. That is, the positive terminal looks like the negative, and the negative like the positive. (See Fig. 28.)

I have constructed several dozen distinct varieties or amplifications of the ordinary type of vibrator, such as multiple contacts, etc.

Fig. 29 shows one form, in which the object was to produce a larger number of breaks of the current per unit of time by providing two contacts, as shown. In some respects this scheme worked well—that is, the light was stronger than that produced by an ordinary vibrator with a single magnet, but the light was not steady, and when the connections were changed so that but one magnet was used, the light flickered still more. All the vibrators, so far considered, have had their springs so adjusted, that the contacts remained normally closed. Fig. 30 shows a circuit using a vibrator normally open. The small magnet constantly closes the circuit, and the large one opens it. This arrangement gave a good light. A number of ordinary vibrators have been operated, arranged with the magnet above the armature, so that gravity helps close the circuit. Of course, springs and armatures of scores of shapes and sizes, including gravity vibrators, have been tried, the principal object being to obtain a method for taking up the wear of the contact points; but the best solution of this problem lay in getting contact points that would not wear because of a more perfect vacuum.

Turning now from the mechanial construction of vacuum vibrators to consideration of their unique properties from a scientific standpoint. As stated before, roughly speaking, the prime object of making the break of the current in a vacuum is to produce an increased C. E. M. F. over that resulting from an air-break. But I venture to say, few as yet realize the possibilities and the tremendous advantages involved in the separation of electrodes in high vacua at regular periods of time. It is, indeed, questionable whether the increased C. E. M. F. of the ether gap is responsible for the results. It is more probably due to the fact that the wave lengths of the current resulting from an ether gap differ radically from any that have heretofore been known of. Recognition of the importance of this phenomenon led me to use the word "etheric"

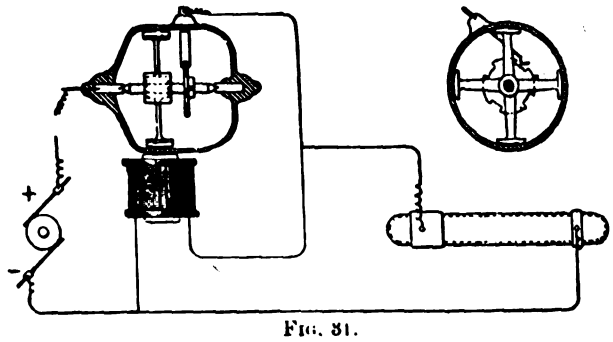

Fig. 31.

in connection with my system of tube lighting, because the light is directly dependent upon what I designate as the ether gap of the vacuum. Our best notion of the separate existence of the ether is formed by thinking of that which remains within a vacuum of the highest degree we can produce. It may have been noticed, that so far I have not used the word "phosphorescent." It is undoubtedly a misnomer as applied to tube lighting; but to make matters worse, there seems to be no word in existence exactly or even approximately suitable.

The word etheric is especially applicable to light produced by the ether gap. That incomparably better results should be obtained by using a vacuum as a dielectric seems to be in perfect accord with accepted theory which has largely been upheld by actual experimentation. For example, setting aside for the time being that part taken by the magnet, let us consider only the break—the spark.

First, what is required is a continuance of the rapid oscillations of an electric discharge, and I desire to show that this is accomplished by a vacuum vibrator in an ideal manner. One method of obtaining an oscillating discharge is to use a potential such that an air-gap of considerable width is bridged by the spark. But the manner in which such discharges succeed each other largely depends upon the irregular movement of the air within the gap.

This method is unsatisfactory for many other reasons, among them the very objectionable high tension required, but there remains the conductive method of causing a spark, exemplified in the ordinary vibrator and induction coil. Here the sparks in the primary circuit can be made to succeed each other quite rapidly, but the length of time required for each complete break is long. However, with the vacuum vibrator, a new and simple device, the conditions are different, and so are the results. Here the dielectric is an exceedingly thin film of ether, which is capable of withstanding a great electrostatic strain, but when it does break down it does so very suddenly—that is, it may be considered a perfectly disruptive discharge, and therefore its single oscillations are very short; but as a whole they are long continued. This means that the frequency is high, and, according to Maxwell, very high frequency oscillations are probably identical with light.

The small magnet, being a circuit of induction, has its own natural period. But its period and moment of inertia will be less, the less its capacity. That is, the smaller the magnet the smaller the period, or the higher its frequency can be.

But to have an intense light, there is required a high E. M. F. of self-induction. This the small magnet furnishes, because what is

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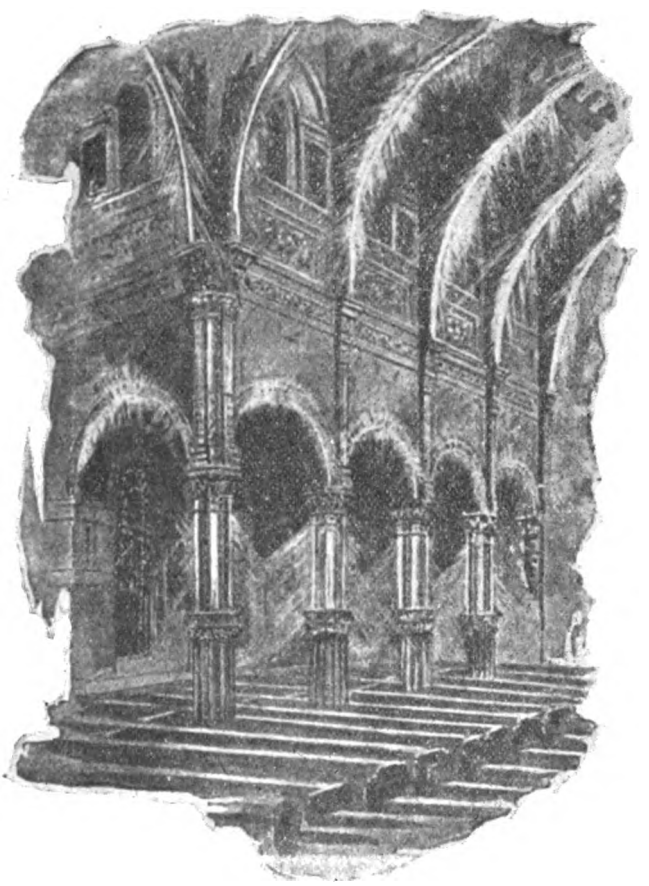
lost in self-induction by using a comparatively few turns of wire is more than made up by the suddenness of the discontinuance of current flow, and the fact that the high vacuum precludes the possibility of loss to the self-induction ordinarily due to the glow discharge which precedes the disruptive discharge in the air. The self-induction also depends on the amount of current flowing through a circuit when interrupted, and this the vibrator provides for, in that all the current which flows through the coil does not pass through an arc, but is transmitted over actual metal contacts. Also since these contacts are so very close, due to the thinness of the dielectric, the oscillatory discharges do not leave the metal and pass in obj ctionable minute streams through the vacuum. And the number of oscillations in the coil and the amount of light, depend in a measure on energy expended to overcome the resistance of the dielectric which is almost infinitely greater than that of air.

That the silent discharge prevents long continuance of oscillation is shown in the Hertz experiments, where the experiment fails unless the balls of the electrodes are kept polished. That the vacuum vibrator is nearly ideal is again shown in that these troubles are almost entirely eliminated. The ether is undoubtedly the ideal medium in which to disrupt an inductive circuit for conversion into light. Since an exceedingly thin film (if this term may be so used) is a dielectric of such strength that a very small displacement results when it is disrupted, and the ether being the medium of minimum rigidity closes the "hole" the instant it is pierced. Such a medium for such a purpose is almost incomparable to air or oil, which becomes volatilized.

In order to get any oscillations, more sudden rushes of curren must occur on discharging than on charging, and the more nearly these equal each other, the quicker the rushes will succeed each other. Now, in the case in question, when the tube circuit with its condenser coatings has a certain capacity, the self-induction of the magnet can be so varied that these two will always neutralize each other, and then the critical strain on the dielectric requires but little energy to cause a discharge, and the circuit being almost balanced, the surges follow each other in rapid succession through the tube. The surges continue for a longer time, since the energy of the discharge is not dissipated in heat on the air, but is conserved to be utilized in prolonging the existence of the oscillations. The use of this vibrator seems to afford the best means yet invented for impressing molecular disturbances in a tube. The longer the oscillations exist, the more nearly the mean oscillation approaches a constant period, and this period is practically governable as compared with that of currents due to magnetic blasts or heated air currents. The higher the frequency, the greater the mean free paths of the molecules, because a less number of molecules will then be required to cause a given number of collisions, and the less the number of impacts, the greater will be the light in proportion to the heat. But the frequency is dependent on the capacity of the condenser, which, in the case of the tube coatings, is very small.

When the self-induction and capacity are properly proportioned, and the rate of the vibrator is the same as the natural period of the coil, or any of its harmonics, then there is resonance, and the maximum amplitude of each impulse will be constant. In this case the current flow is at its maximum, but so also is the voltage at the ends of the tube, as well as the quantity of light produced with a minimum expenditure of energy. The velocity of the lines of force produced by an oscillatory discharge is supposed to be equal to that of light, but its wave lengths are exceedingly greater. But this disparity is greatly reduced by the vacuum vibrator. This accounts for the insense light in the tube at comparatively low potentials, and indicates that nature's keyboard has been struck to the tune of 500 trillions of waves per second, and that this rate is maintained by the fundamental mechanical vibrations of the vibrator—about 100 per second—a most bleautiful demonstration of nature's wonderful compass. But not only is more light produced by the vacuum vibrator than was heretofore obtainable, but there accompanies it many other advantages of particular importance. Three of these can be mentioned: fiirst, simplicity and greatly reduced cost of apparatus; second, the obviation of impracticable potential, and, third, a very marked advance in economical production. The first heading, simplicity, has already been dwelt upon. Compare an inexpensive magnet, not as large as one's hand, and a vibrator the size of one's finger, attached to commercial currents, with apparatus costing thousands of dollars, consisting of a high speed alternating dynamo of many coils, oil transformers, disruptive discharges with magnetic blast, induction coils and condensers. The many seemingly unsurmountable difficulties encountered with this method, are almost completely overcome by the simple expedient of the ether gap. Or, referring to ordinary induction coils, the vacuum break affords a means for obtaining from the few turns of comparatively coarse wire, results not obtainable with mammoth and expensive coils, made of many miles of wire, and capable of creating enormous differences of potential.

The second heading is essentially a practical one. It has often been argued, to the detriment of tube lighting, that since it was admitted by its supporters that enormously high potentials were absolutely requisite to cause any appreciable amount of light, that therefore (and the argument was logical) the whole idea was extremely impracticable unless some new insulator be discovered, that could cope with the high potentials, so difficult, dangerous and expensive of generation and manipulation, as to prohibit their use commercially. But with a current endowed with such properties as are given it by a vacuum tube vibrator no new insulator is needed.



A light now results many times brighter than that formerly due to millions of volts, able to pierce several inches of hard rubber, or produce a spark many inches in length, from a current transmitted to the bulb or tube over ordinary flexible cord, and whose sparking distance is less than one-sixteenth of an inch. Neither can any shock be felt from such a current. Another example of the comparative case with which this new current can be insulated is apparent in the magnets, wound in the ordinary manner, in striking contrast with the necessity for expensive and cumbersome oil transformers. In this light the exclusion of all gaseous matter does not seem to be a matter of such vital importance.

Closely allied with the subject of insulation is that of frequency. The higher the frequency, the lower the potential can be, not only with respect to light, but also to insulation, because irregularity in the rate of vibration puts the insulation to a severe test. However, the period of the vibrator is not rapid as compared to that of alternating dynamos, constructed to obtain similar lighting effects, but resulting in those of lesser degree. The alternations of such a ma-

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chine are about 30,000 per second, which is further increased by a disruptive-discharge coil. This was necessary to compensate for the long wave lengths of the current. But since these lengths are so much shorter in the vacuum vibrator current, an initial frequency one-fifth as great, without the use of additional coils and condensers, produces far better results. But that an ordinarily constructed vibrator can attain a speed of 6,000 per minute, may be questioned, when it is remembered that induction coil vibrators work at a rate of but a little over 1,000. The difference lies in the fact, that the vacuum vibrator has no air pressure to impede its movements, and also that a much shorter space of time is required for a single complete interruption, because the actual mechanical movement can be much less, yet cause a complete break, and another cycle has begun. The speed of the vibrators is ascertained in two ways: First, by comparing the musical note it produces with that of a pitch pipe, and, secondly, by a visual arrangement constructed and operated as follows:

A shaft, supporting a wheel with one spoke, is rotated rapidly by hand, a series of multiplying gears being used, so that when the hand makes one revolution per second, the spoke makes twenty. When this apparatus is operated in a room, lighted only by a single vacuum tube, the spoke will appear stationary in one, two, or three positions, according to the rate of the vibrator. For example, if the spoke appears stationary in two positions, it indicates that it is illuminated twice in a single revolution, each image being due to a vibration.

Another subject, which has been a serious obstacle in former proposed systems, is that of impedance. The fact that the best conductors would cease to transmit current, seemed a difficulty almost unsurmountable; yet it appears to be almost absent under these new conditions. For example, when a large coil is inserted in the high potential lead from the armature terminal to the tube, the effect on the light is surprisingly small. The result is the same, whether the wire be in the form of a magnet, or in a long exposed line. But, nevertheless, on account of line losses, it is advantageous to prevent condenser action by using a wire as small as possible, yet able to stand the strain it is subjected to when its insulation is being placed upon it. Although the light produced by a single wire is quite good, it is decidedly advisable for best results to use a return wire, because the fundamental frequency is so low.

The third subject—economy—is so large, and of such importance that I deem it expedient to make it the subject of a future paper when accurate measurements have been made. Indeed, it is second only—but it is second—to the nucleus of the whole investigation—namely, getting light. The efficiency of the lighting tube is well established, due principally to the great amount of light accompanied by so little heat that it has by some been called "cold" light. The temperature of the gas within the tube varies with the density of the discharge from 12 to 132 C.; but even this is improved by the shorter wave lengths. These figures are extremely low, as compared with temperatures as high as 3,500 C., which must be reached by some substances in order that the light be white and the spectrum complete.

Owing to the peculiar characteristics of the current, the line losses are materially decreased, and the current flowing through the primary circuit is less when the tube is giving light, than when it is disconnected. There are almost no losses for motive power to disrupt the current, for the magnet is its own motor. But the greatest loss has always been in the disruptive discharge—the spark. It is remarkable how easily several horse-power can be dissipated in the air through the intervention of a disruptive discharge. In this connection it should be borne in mind that magnetic blow-outs and air currents are merely heat dissipaters, and increase the loss, while these losses are entirely obviated by the vacuum vibrator. The current can perform a large amount of work on the air, unlimited in volume, with no apparent results; but when this volume is reduced to the compass of a small vibrator tube which remains perfectly cool in operation, does not the question of efficiency assume a different aspect?

Upon these reasons may be based logical conclusions, pointing to an enormous increase in efficiency over that of all other methods of obtaining light in tubes.

The theory which has just been considered, of course, is not limited to a simple vibrator, but applies broadly to any method of interrupting the flow of current through a high vacuum. This can be accomplished in a great variety of ways, although as far as simplicity of apparatus is concerned, the regular spring vibrator, in connection with a single magnet, probably cannot be improved upon.

The first deviation, however, is to use a very small magnet to vibrate the armature, and to connect this in series with a larger one to furnish the induction. But in these cases the power of the operating magnet depends on the current passing over the contact points; hence to make the light which is dependent on the contact points perfectly positive, the power should not be dependent upon them, and separate circuits suggest themselves—that is, cause an intermittent current to flow through the power magnet that does not flow through the contact points of the vibrator, which have in circuit with them the inductive magnet. Or the electrodes can be separated by mechanical jarring instead of magnetic power acting through the glass.

If an ordinarily constructed vibrator be attached to any form of rapidly oscillating mechanism, the contacts within will be opened and closed rapidly. But in order that the light be steady, the movements of the vibrator armature must be in step with the movements of its mechanical support. This is best accomplished by having the centre of the oscillation of the vibrating armature coincident with that of its oscillating support.

It is plain that it is unnecessary that the current be interrupted by a reciprocal motion only; a rotary motion is also applicable.

Fig. 31 shows a form somewhat analogous in operation to the simplest vibrator, except that the rotary momentum of the armature takes the place of a spring, and the break-wheel which furnishes the light also acts as a commutator to the simple form of motor.

Another way of obtaining a rotary motion within a vacuum is to attach a pendant weight to a ratchet wheel, free to rotate upon a shaft attached to which is the brush. Since the shaft is rigidly sealed into the glass, it is evident that when the bulb be rotated by a motor, the brush will revolve around the break wheel. The fault with the device is that the pendulum will have a vibration of its own, causing the light to waver.

In order that the make-and-break devices dependent upon a rotary motion be absolutely positive, a rotating magnetic field has been utilized. Since the experimental side of these investigations has extended over but a few months, it is at present difficult to say upon which of these methods, developed, the system will take final form.

Returning once more to the subject of the light in the tube. It is interesting to note, that although the most intense light is produced when both of the ends of the tube are connected to the electrodes, it is well known that light also results when the tube is merely placed near an electrode without actual contact. This phenomenon is known as lighting by induction.

If an inductive circuit, sufficiently powerful to brilliantly illuminate a tube four feet long, be transferred to one two feet long, there will appear at the centre of this small tube a very intense thread of silvery white light, which undulates as if it were a material substance. It is interesting to contrast the color of the light of these tubes with that of an incandescent lamp. The reddish and wasteful glare of the latter, indicating heat waves, and the pure daylight white of the former, is immediately apparent. It is this difference in color that makes an efficiency calculation so difficult. It is very easy to ask the question: How many Watts per candle-power? But in most instances it indicates a lack of information on the part of the questioner. The question should be: How many Watts per amount of light equivalent to one candle-power? But even this is not perfectly correct, because it is well-nigh impossible to compare accurately lights of a different color and power of diffusion. When the use the light is to be put to is stated, the problem is much more simple. For instance, if it is to be used to read by, the range of legibility can be made the basis of comparison between the true glow lamp and the candle. This most popular form of illumination, from the 12th to the beginning of this century, is still the standard of illumination, although it is probable it will soon be deprived of this honor. I may be pardoned for calling your attention to the remarkable intensity of the light in these tubes, in connection with the

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statements repeatedly made by eminent scientists, that such intensity was an impossibility, and that efforts in this direction were comparable to those wasted on perpetual motion. It is merely another instance of history repeating itself, in that in all times the inertia of the learned has interfered more with the progress of science than has ignorance. Be it remembered that the commercial incandescent lamp was an acknowledged impossibility among scientific men, and that by them the proposed Atlantic cable was considered foolishness. If there be but one lesson taught by our times, it is, condemn nothing new in religion, science, or art without thorough investigation, and even then be careful, because many suggestions, though of little value themselves, have led to great advancement. It is also well to remember that there is almost a creative force in the spirit that is earnest and courageous. The light having reached the intensity, as you see it in this tube, it is questionable whether much greater intensity is wanted. The vibrator, as applied to the electric bell, was the first practical application of electric power, and to-day we see the same vibrator in a "new light."

The very nature of the light, if it is to be counterpart of the ideal daylight, is such that when a square inch of the surface of the tube emits as much light as that thrown into a room through an aperture one inch square, the want is satisfied. Then the desired illumination can be reached by multiplying the area and length of the tubes, and distributing them in the most advantageous manner—that is, so that the light will fall from all directions. When a considerable area is to be lighted, the most efficient light is the one that is most equally distributed. However, there will always be a demand for units of light. Even this can be satisfied by using a tube of small calibre. This lamp is made by winding a small tube in the form of a spiral, its ends, to which the wires are attached, terminating in oblong bulbs three or four times the diameter of the small tube.

I have previously stated that the alphabet has been constructed of tubes of light. Here are the initials of the body I have the honor to address, A. I. E. E., in letters twelve inches high. The delicate shades of these letters cannot fail to elicit admiration from all who love the beautiful.

The principle of breaking a circuit in a vacuum has many applications to a variety of uses. Among them may be mentioned, advertising signs, decorative electric lighting, electrotherapy, philosophical apparatus, theatrical effects, in the manufacture of ozone, in the kinetoscope, etc.

But the greatest field will ultimately be that of general illumination. You have noticed the tubes extending around this hall. Undoubtedly this is the first time that lighting by tubes has been attempted on so large a scale. You will note the almost entire absence of shadows.

Fig. 32 illustrates what we are coming to in the way of church lighting. For some time past everything has pointed to the general adoption sooner or later of some such form of illumination, and since volumes of light can now be produced, and of commercial intensity, does it not indicate that already this light is a matter for serious praitical consideration, and no longer a pyrotechnic curiosity?

METROPOLITAN COMPANY NEWS.

John Gorman for twenty years practical electrician and dealer in electrical apparatus in St. Paul will represent the Metropolitan Electric Company in handling N. I. R. wire, Metropolitan lamps, "Mac" tape, P. & B. compound varnish, etc.

Mr. Gorman is prominently identified in electrical interests in St. Paul and Minneapolis, and has done a large share of the electrical work in that section during the last twenty years. The Metropolitan Electric Company can be congratulated in getting Mr. Gorman to handle their goods.

Metropolitan Electric Company has just taken the agency for the Diehl Manufacturing Company, of Elizabethport, N. J., and will carry in stock a complete line of their ceiling fan motors. The Diehl Manufacturing Company are the oldest manufacturers in the country of ceiling fan motors in their various shapes and styles, and the Metropolitan Electric Company are fortunate in securing this agency.

ROENTGEN PICTURE OF INFANT.

Drs. Morton and Chapin, of New York Report Some Good Results.

History of the Case, by Dr. Chapin.—William J., aged six weeks, was admitted into the Babies' Wards of the New York Post-graduate Hospital on March 17th, 1896. He presented a typical clinical picture of a condition very often seen in infants' hospitals and dispensaries, due to bad food and air, and popularly known as marasmus or atrophy. The mother was unmarried, without means, and had fed the baby since birth on canned condensed wilk. For two days previous to its admission the baby had vomited all its feedings, suffered much from colic, and had rather constipated, green stools. Its weight, on admission, was six pounds, eleven ounces. The temperature varied from 97 to 101 degrees F., the pulse from 100 to 150, and the respirations from 30 to 50. In spite of careful nursing and feeding, the infant was unable to assimilate its nourishment properly, and died on April 9th. It occurred to me that this would be a good case to test the transmissibility of the Rœntgen rays, and accordingly I requested Dr. William J. Morton to undertake the experiment. The method employed will be explained further on by Dr. Morton.

The osseous system is exceedingly well marked, the wrists, hands, feet, and various other parts showing the stage to which ossification has advanced at this period of life. The internal organs show more plainly on the negative plate than in the print. On the former, faint traces of the convulsions can be noted. The heart and liver are seen in shadow, and the distended stomach and intestines stand out pretty plainly. The autopsy showed a healthy brain, beginning hypostatic pneumonia at the base of the right lung, a very black liver due to infiltration of bile and decomposition, and a catarrhal condition of the stomach and bowels, which were much distended with gas. On the plate, a slight difference in shading suggests the position of the congested, unaerated lung. The success here attained with the viscera justifies us in the hope that, with improvements that are constantly taking place in this process, the internal organs may be located and investigated in time as successfully as the bony system is now laid bare to the surgeon's eye.

The Picture, by Dr. Morton.—The Crooke's tube was placed at a distance of fourteen inches above the child and in a vertical line above the epigastric region. The sensitive plate was inclosed within a cardboard box. Probably less than forty minutes actual time was consumed in affecting the plate. With the excitation of tubes now at command, fifteen minutes would suffice to produce the result shown. Since the bones of a child of this age are so freely penetrated and traversed by the X-ray, the contrast between flesh and bones is not so marked as in the case of adults. In relation to showing the situation of organs, this is largely a matter of the time of exposure. An under-pressure shows the organs in silhouette, while with a longer exposure the rays soon penetrate the plate and obliterate the record. The picture here reproduced was timed to show the skeletal bones only, and therefore does not do full justice to the possibilities of location of other internal parts.

THE OKONITE COMPANY MOVES.

The annual May day movers this year will have the Okonite Company at their head. For many years Captain Candee's Company has occupied commodious quarters at 13 Park Row, New York, and it will seem strange not to see the big familiar sign in front of the post office. But then the officers of the company have so many friends, and do so much entertaining that they have evidently come to the conclusion that they had better locate in the neighborhood of the Hardware Club, where they can open a keg of nails for their friends without going out of the building. They have, therefore, "adjourned" permanently to the Postal Telegraph Building, 253 Broadway.

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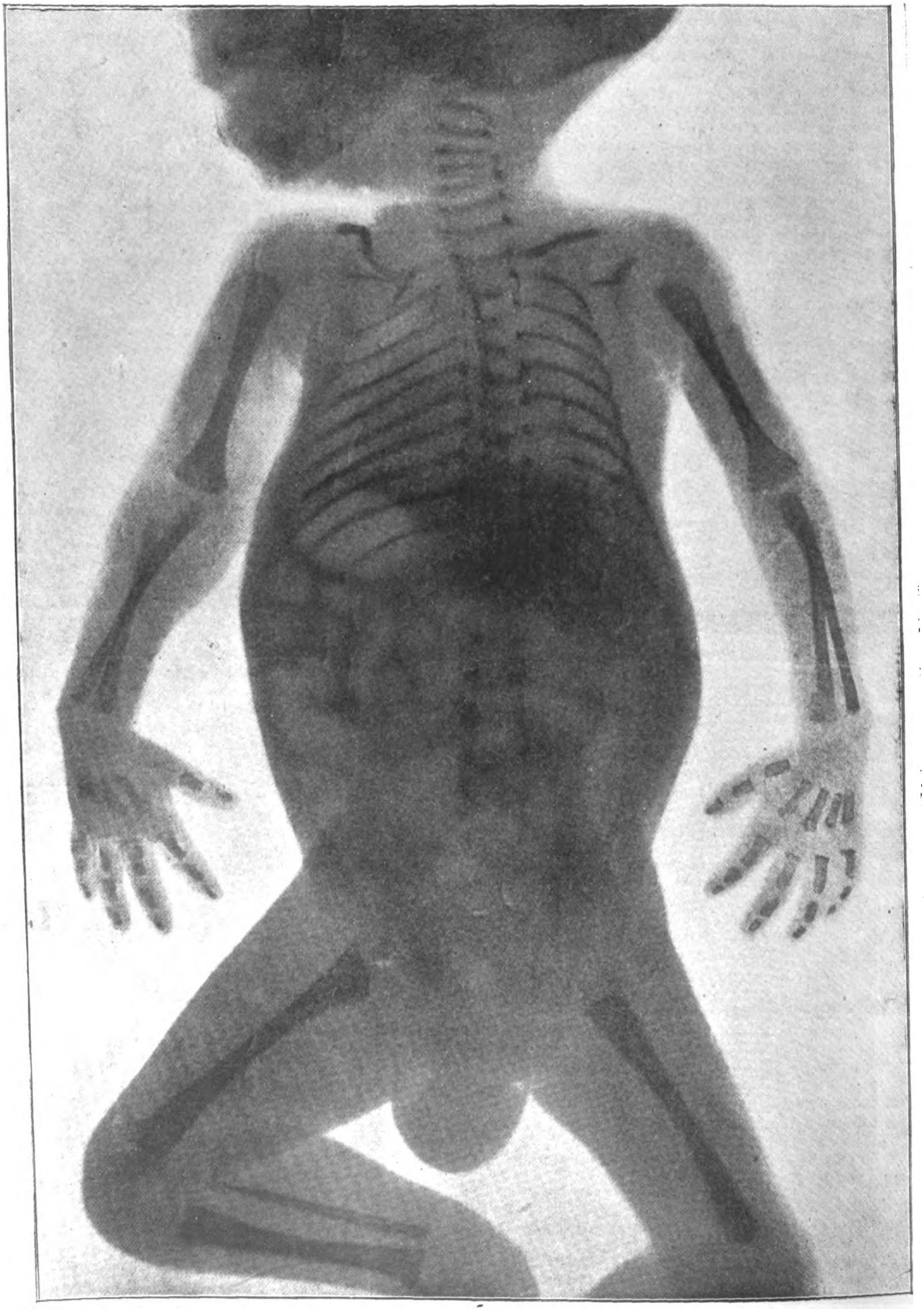

Roentgen Picture of Nine Weeks Old Infant. (See Page 468.)

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WILHELM KONRAD RÖNTGEN.

Born at Zurich 1846. Eminent German Scientist, Professor of Physics, University of Würzburg, Bavaria. Discoverer of the so-called Röntgen, Cathode or X Rays.

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The Electrical Journal.

Vol. 1. CHICAGO, MAY 15, 1896. No. 24.

OPENING OF THE N. E. L. A.

President C. H. Wilmerding Outlines the Direction of Improvements Since the Columbian Exposition.

United States Far Ahead in Electricity.

MEMBERS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION—LADIES AND GENTLEMEN:—

The National Electric Light Association owes its birth to a meeting of those interested in the problems of electric central station lighting held a little over eleven years ago, on the 25th of February, 1885, at the Grand Pacific Hotel in Chicago. Many of those who came together at that time are here to-day—a little older, it is true, and a great deal wiser in matters pertaining to the subjects they met to discuss; in fact, if we turn to the records of that first meeting, we can but be struck by what, in the light of our present knowledge, appears to be the lamentable ignorance of those same gentlemen; and yet it must be remembered in their favor and in extenuation that they knew as much as could have been expected of them in those earlier days of electrical development. They meet to-day in their nineteenth convention, and those of you who will follow the proceedings will see that they have improved—it is only fair to give them this opportunity to vindicate themselves—and I think I may add that you will find at the end that the improvement has not been entirely one-sided.

In these few years the central station for the production and dissemination of electric current for lighting and power has practically been developed. It barely existed in those days. It is needless to say that it enjoys a very vigorous and healthy life at the present time. It is, I think, without undue self-congratulation that we can say that the Association has contributed its share to this progress, and we therefore owe a debt of gratitude to those who met in Chicago; for even if they did know very little about electricity, they foresaw the wisdom of co operation and the value of the free exchange of thought and ideas which have made the Association what it is to-day.

The object of any such organization as this is primarily the advancement through mutual intercourse of its individual members, and secondarily the fostering and protection of their common interests. In both of these fields we can say with some pride that this Association has, since its inception, steadily advanced, and with each year of its growth we have seen that it exerted a greater influence, that it afforded a greater opportunity for the acquirement of technical and practical knowledge, and that in proportion as it has become a stronger and more homogeneous body it has grown to be a greater necessity to central station interests. In this twelfth year of its existence we hope it may keep up with the steady improvement of former years and advance as nearly as possible in lock step with the progress of electricity itself.

When our fellow-countryman, Benjamin Franklin, flew his silken kite, an event which marks the first step toward present achievements, he drew from the clouds a tiny spark. That spark was then but like the twinkle of a star, billions of miles away. It hinted at the existence of an unexplored world, but so faintly that the most powerful telescopes of imagination failed to measure its dimensions or to determine its course. Gradually new facts were added, one by one, concerning this mysterious, distant star; it grew brighter; it was certainly coming nearer and nearer within the reach of man, but it was only a few years ago that it assumed the proportions of a body of the first magnitude, and so rapid has since been its onward progress that to-day that tiny spark has grown to a brilliant midnight sun, dispelling darkness throughout the civilized world. Such has been the meteoric course of the science which brings us here now. What in the days of our childhood was scarcely more than a toy—at best the interesting and mysterious phenomenon of the scientist's laboratory—is in these closing years of the century the mightiest agent known to man. By its means the news of the world is gathered from its four corners in less than a second's time; yesterday it carried the command by which Governor Morton called the wheels of our Exposition into life over 6,000 miles, from the Atlantic to the Pacific and again to the Atlantic, at a touch of the finger and in less than the twinkling of an eye. Through its agency the softest whisper of the human voice is transmitted a thousand leagues, or recorded and preserved for the ears of future generations; the divisions of time are so integrated as to enable the eye to follow in reproduction the continuity of the most rapid motion: night is turned into day, darkness into night; the waste forces of Nature are harnessed and wafted like spirits, unseen and instantaneously, over mountains and rivers, miles upon miles, to turn the busy wheels of distant industry; the hidden secrets of Nature are laid bare by the ray that pierces dense matter with the ease of a shaft of sunlight traveling through thin air. One miracle has followed another until we can but wonder what apparent impossibility will be accomplished next. The fables and fairy tales of old pale before the facts of the present day.

Nothing could show more succinctly the various steps of this advance than the Historical Exhibit forming a part of the Exhibition opened in connection with this Convention, which we owe to the efforts of Mr. T. C. Martin, Mr. Morse and Mr. Park Benjamin. The literature of the science is shown from its earliest infancy: the crude original designs are there of apparatus which has since attained perfection; the gradual growth of many great ideas is fully illustrated from their inception, and it is only necessary to turn to the other and present day departments to see them in their completed forms, and to realize the recent extraordinary achievements of electrical inventors. Supplementing this is the prolific exhibit from the Patent Office, an inspection of which can leave no further doubt as to the activity which has been going on in this field of science.

The last exhibition of this nature was the great display at the World's Fair at Chicago in 1893. Only three years have elapsed since then, and yet it can be plainly seen that in the meanwhile a sort of Darwinian evolution has been going on, developing things then unheard of and unknown, though the natural progeny of earlier germs, now fructified by the power and genius of the great minds that have fathered them.

The most recent of these triumphs of science, and the one which has attracted the most widespread interest and perhaps promises the greatest results in a scientific way, is the marvelous discovery of Prof. Roentgen—the Cathode or X ray. Thanks to the courtesy of Dr. Thomas A. Edison, the application of this strange light, the methods employed to obtain sciagraphs and the use of his newly invented fluoroscope, by which one can see as through a stereopticon the bones of one's

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own anatomy, are graphically shown and explained by the assistants from his laboratory.

Equally new to the world, and first brought forward by another of our distinguished honorary members, Mr. Nikola Tesla, are the beautiful and curious effects in lighting produced by high frequency, high voltage currents, which will be shown by Mr. McFarlan Moore as he has developed them and applied them to practical use. Mr. Moore, perhaps in a true spirit of prophesy, describes this as the "Light of the Future."

Still another invention which has seen the light of day since the Columbian Fair, and also owes its origin to the fertile brain of Mr. Tesla, is the oscillator, by means of which unique contrivance much of the machinery now required for generating electricity is dispensed with, and current is derived directly from the energy of steam.

Although the mere transmission of current over long distances is not absolutely new in the sense that the expression must be taken in speaking of things electrical, for it dates back three or four years, yet all the features of the great example of such transmission shown here are individually novel, and the exhibit as a whole may be classified as one of the most significant of all. The generators producing the current at Niagara, as well as the turbines that actuate them, are the largest that have yet been built and successfully operated, and the two-phase winding of the former represents the latest advance in the construction of dynamos for the distribution of power. The line carrying the energy to this city traverses a distance of 462 miles, which is 347 miles longer than the celebrated Frankford transmission, the longest hitherto attempted. the successful accomplishment of this feat is an indication of great future possibilities in the utilization of natural advantages for the supply of power over wide areas and at the same time adds a further argument in favor of the rapidly growing tendency toward unification and centralization of generating plants.

A reference to these more strictly scientific advances in electricity leads to the consideration of its growth commercially. Figures are certainly the most convincing expression of the measure of achievement in this direction, and the following facts will carry with them their own conclusions:

About seventeen years ago the first central station was established; at present there are 2,500 electric light companies in the United States and about 200 municipal plants. These central stations represent an invested capital of over three hundred millions. There are in addition about 7,500 isolated plants, which have required the expenditure of two hundred millions more. An idea of the capacity of these ten thousand installations may be formed when it is known that there are produced daily for their use from fifty thousand to seventy-five thousand incandescent lamps; that the annual consumption of carbon in arc lamps is two hundred millions and that five hundred thousand stationary electric motors are operated by the current which they generate.

The electric railway is of still more recent birth, dating back but ten years, and yet at the present time there are no less than nine hundred such roads in this country, using eleven thousand miles of track, operating twenty-five thousand cars and involving an investment of about seven hundred and fifty millions of dollars, and this investment is increasing annually at the rate of one hundred millions for new roads and new equipment. While these are large figures, they do not at all represent the total capital employed in electrical industries. The manufacturers of the apparatus and supplies used to carry on this enormous business, and the dealers who handle them, have at stake probably a sum sufficient to build and equip all the central station plants in the country; and if the anxiliary enterprises, such as those of the producers of copper, the makers of boilers, the engine and car builders, fixture manufacturers, glass workers and a score of others who depend in a large degree and in some cases exclusively upon the electrical trade, are considered, the grand total would reach a sum that any country might be proud of as a national debt.

This astounding growth affords a striking example of American enterprise as compared with that of the Old World. Against nine hundred electric railways in this country, there are less than one hundred in all Europe; and as to electric lighting, the output of a single company in New York, or of a single company in Chicago, is greater than the combined output of all the stations in the brilliant city of Paris.

The short period since our last meeting has in itself marked an epoch of the greatest importance in electrical engineering. The Niagara Falls power plant has been completed and put into successful operation. The first elevated electric railway, the Metropolitan of Chicago, has been opened for public travel, and has already demonstrated that such a road can be operated at about one-half the cost of a steam road, and making it merely a question of time, and a short one at that, before all elevated trains must be propelled by the same cleanly and economical means.

The first powerful electric locomotives of the Baltimore and Ohio Railroad have been put into regular service in the Baltimore tunnel, drawing the heaviest trains, and furnishing an example which other railway companies are already preparing to follow. This is undoubtedly the first step toward a general revolution in the methods of transportation, which will result not only in greater comfort and better service to the public, but such a saving to the companies themselves as will place many a road now on the verge of bankruptcy on a prosperous and dividend paying basis.

I am glad to be able to say that while everything else electrical has been forging ahead, the National Electric Light Association has not been standing still. The reports which will be submitted by the Committee on Rules for Safe Wiring and the Committee on Data will show that they have accomplished much valuable work during the past year. The progress which has been made by the former committee toward bringing about the general adoption of a national code of rules for electrical installation is especially gratifying, and we may at last hope that this much to be desired and long deferred result of their labors may soon be attained. We have all suffered from the lack of fixed standards governing electrical construction and from the arbitrary rulings of self-constituted authorities on this very important subject, and the establishment of a board composed of competent and representative men, whose rules will be consistent, and as far as possible permanent, is one of the greatest of our needs, the realization of which should be one of the first aims of the Association.

The report also of the Finance Committee will be found interesting and extremely satisfactory, showing as it does that our treasury is in a better condition than ever before.

We have been particularly fortunate in securing papers to be read before this convention upon subjects which are timely and of special interest to central station men; and I desire to take this opportunity to thank the gentlemen who have prepared them and who will read them, for their willing co-operation with the officers of the Association in their efforts to make this meeting a successful and an instructive one.

I trust, gentlemen of the Association, that you will all co-operate towards this result at least to the extent of regular attendance at our sessions, resisting while the Convention lasts, if not longer, all the subtle temptations and seductive allurements of this fair City of Greater New York.

Cripple Creek, Col., has a fine brick electric lighting and power station, with a capacity at present of 170 arc lights and 2,250 incandescents. Both wood and coal are used for fuel; but as coal costs $5.85 per ton, wood is preferred, and the prices for lighting are naturally high. A 1,000 H. P. addition for power distribution is among the possibilities.

An eighty arc lamp dynamo of the Brush Company make has been ordered for the Warren Electric Light and Power Company station. It will add materially to the capacity and efficiency of the plant.—Warren, Ohio, *Chronicle*.

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NEW YORK EXPOSITION.

Special Correspondent—William H. Hale, Ph. D.

In this age of progress, we may often remark that every new exposition marks an epoch. Certainly this is true of the electrical exposition now in progress. We have the X rays, the etheric light, the long distance transmission of power and sound, besides the innumerable improvements in apparatus and methods.

THE OPENING NIGHT.

A great crowd was present on the opening night, and the program went off nearly as arranged. Mayor Wurster, of Brooklyn, presided, however, instead of Mayor Strong, of New York. When Gov. Morton touched the golden key, formerly of the World's Centennial Exposition at Chicago, all the cannon boomed except that on the roof of the exposition building, that is to say, at Augusta, Me.: St. Paul, San Francisco and New Orleans. At the same time the machinery started, and Moore's vacuum tubes arranged to constitute a large frame in front of the Governor, and surmounted by the legend also in vacuum tubes, "Let There be Light," flashed into etherial azure beauty; "the light of the future," as it has been called.

At the same touch also the power of Niagara was turned on, and a new record was made in long distance transmission, the power having been conveyed 465 miles by ordinary telegraph wire. In the middle of the hall a model of the Niagara Power Company's plant shows in miniature the locality whence the power is transmitted; and the roar of Niagara was then heard by those of the visitors who succeeded in getting one of the numerous telephones which surrounded the model.

FREDERIC NICHOLLS, OF TORONTO, CANADA, PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

THAT CIRCLING TELEGRAM.

"Our Chauncey" did not send that message around the earth, but he will do so next Saturday, covering a circuit of 28,000 miles, as far as Australia, through the Mediterranean, and back around the Cape of Good Hope, Brazil, Mexico, San Francisco, Winnipeg, St. John's, N. B., and back to New York.

MODEL OF ERIE CANAL.

The model of a section of the Erie Canal shows the trolley system which will soon be put in operation, power being supplied from Niagara. Two wires are employed and the motors will weigh a ton each and haul four canal boats.

There is quite an elaborate exhibit of early electrical books and inventions, including many models loaned by the patent office.

THE COOKING EXHIBIT

Is a great attraction, especially to ladies, who can appreciate fresh biscuit without having to discuss volts, ohms or amperes. Moreover, this application of electricity seems to appeal very strongly to the household economist.

Near by is a piano played automatically by electricity, and this too affords a fund of amusement to the audience.

On the other side of the cooking exhibit a little room weirdly lighted by invisible lamps also attracts the children as well as children of a larger growth. In one corner we have a ship at sea, tossing on the waves by moonlight; while in another corner Little Red Riding Hood is sitting in the forest, with brownies appearing and disappearing by electric illumination, and a cat whose eyes blink with electric fire.

While part of the power employed in the exposition comes from Niagara, most of it is derived from a steam boiler plant of the latest and best description. The boilers are supplied with all automatic devices, coal being supplied and stoked automatically, and ashes removed; while improved safety appliances guard the boilers and prevent the possibility of explosion, so that the engineer's work is reduced to a minimum, and in demonstration of this a woman has been placed in charge of the boiler plant, and has really almost nothing to do, so perfect are all the automatic arrangements.

WESTINGHOUSE EXHIBIT.

Immediately upon entering the main door of the Exhibition is noticed the space occupied by the Westinghouse Electrical Manufacturing Company, of Pittsburg. There is a beautiful red and gold sign suspended above the exhibit, but even without that it could be easily recognized that this is the place where the Westinghouse people are holding forth, inasmuch as Tesla motors and other Westinghouse apparatus are plentifully in evidence. Mr. A. C. Zimmerman, of the New York office, and Mr. M. MacLaren, from the Pittsburg factory, are in charge of the exhibit. Mr. MacLaren has been especially detailed to look out for the power transmission from the Niagara Falls power current. The company has on exhibit a lamp-board in the centre of which is seen the Shallenburger electric meter. The case of this meter has been removed and in this way the actual operation of this well-known device is plainly demonstrated, and it attracts a great deal of attention. Another interesting feature is an illustration given of the principle of induction, which is demonstrated with an induction coil. The company's exhibit is lighted up with the well-known Sawyer-Mann lamp. On the floor stands a twenty-horse power Tesla motor, driving a twenty-horse power D. C. generator. In addition to that, there were several other Tesla two-phase motors, single-phase motors and a number of convertors. Mr. C. F. Scott, the electrician of the company, Mr. Allen, from the Philadelphia office, and Mr. E. H. Heinrichs, the advertising agent of the company are in attendance.

PORCELAIN EXHIBIT.

The Peru Electric Manufacturing Company of Peru, Indiana, is represented at the Electrical Exposition by R. H. Bouslog, its secretary, treasurer and manager, in fact "Pooh Bah" generally.

The company makes a creditable exhibit of specimens of porcelain baked very hard by natural gas at a temperature of 4,000° to 5,000° F. The vitrification is so perfect that the ware stands the test of ink not spreading when applied to the unglazed ware.

The glazed ware has this notable superiority over ordinary glazing that no metal is employed, hence it is infusible and does not attract the electric current as common glazing does. In a recent contract for one of the largest electric concerns, the ware successfully underwent the severest tests. The glazing is done by lime instead of lead, the usual material employed. This company alone employ this process.

It will be recollected that the Peru Company have recently furnished some fixtures for some of the public works of Chicago under the supervision of Mr. Barrett, the editor of this paper, and in accordance with his order. The company regard such orders as indicative of well deserved preference of their product by competent judges.

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FAMILIAR EXHIBITS.

Among the exhibitors I notice as names familiar to your readers, the Western Electric Company, Brush Electric Company, Westinghouse Electric Company, Western Telephone Construction Company, Interior Conduit and Insulation Company, Okonite Company, Weston Electric Company, General Electric Company, Kerite Company, Gordon-Burnham Battery Company, Adams Bagnall Electric Company, Electric Storage Battery Company, J. A. Roebling's Sons and the Peru Electric Manufacturing Company.

X RAY EXHIBIT.

Quite a large number of X rays pictures and negatives are exhibited. A set of large fluorescent screens, with numerous vacuum tubes and powerful batteries, adequate to show well the bones of arms, and perhaps the whole body, is promised, but at time of writing has not yet been shown.

Another interesting exhibit, still only a matter of expectation, is apparatus capable of 10,000,000 voltage, promised by Tesla.

ORIENTALS AT THE EXHIBITION.

The visit of a party of Coreans *en route* to attend the coronation of the white Czar of Russia was a picturesque event on Thursday evening. There were two nobles with unpronounceable names and their two attendants. They were attired in the flowing costume of their country, and wore headgear of wire instead of hats.

THE N. E. L. A.

The electric light people had a large convention. The paper of L. A. Ferguson on acetylene gas interested the general public very much because of the extravagant claims recently made as to cheapness of its production. Mr. Ferguson showed that even with the cheap power of Niagara the gas would cost at least 37.7 cents per thousand in gasometer against 30 cents for water gas, so that the latter is not likely to be superseded for general use. The lectures were by Max Osterberg on "The Roentgen Ray," and by D. McFarlan Moore on "The Light of the Future."

Thursday evening was given up to a very pleasant excursion to the factory of the Crocker-Wheeler Company at Ampere, N. J., which was attended by about eight hundred people.

The new officers of the Electric Light Association are Frederic Nicholls, of Toronto, president; H. J. Clay, of Philadelphia, first vice president, and J. J. Burleigh, of Camden, N. J., second vice president.

COLORING MATTER BY ELECTROLYSIS.

We have already had occasion to notice that some of the coloring matters hitherto only produced by strictly chemical processes, can also be manufactured by electrolytic processes, and it seems extremely likely that the near future will see a very large number of such substances being made by electro-chemical means. Towards the end of last year it was discovered that certain orange coloring matters can be obtained by electricity, and now we understand that they are being made on a commercial scale at Basle, in Switzerland. It seems that by reducing the yellow alkaline condensation products of p-nitroluene sulphonic acid in an alkaline solution by means of the electric current, the yellow coloring matters are converted into orange dyestuffs. A mercury cathode is preferably employed, as the production then proceeds at a lower temperature. The best strength of current is 5—15 amperes per square decimetre of cathode area. About 10 kilos. of p-nitroluene sodium sulphonate are condensed in the usual manner an aqueous solution with 30 kilos. of soda lye of 30° B. After dilution with 70 litres of water, the whole is reduced at 45° C. in an electrolytic cell with a mercury cathode until a sample is spotted on paper which shows a red spot free from yellow. The solution is then neutralized and the dyestuff salted out. After filtering and drying, it forms a dark brown powder easily soluble in water. with a yellowish-red color, and in concentrated sulphuric acid with a dark violet-blue color. It dyes unmordanted cotton orange from a neutral or alkaline bath, fast to air, chlorine and acids. If this new process stands the test of time, and succeeds in producing dyes which possess as good qualities as the same substances manufactured by chemical processes, and at the same time possess commercial advantages, we may anticipate that a new and important field will be opened up which may be usefully exploited by those who complain that the electrical profession is overcrowded.

ELECTROLYTIC GALVANIZATION OF IRON.

The electrolytic deposition of zinc upon iron surfaces is at present worked under three processes namely, first, that of Cowper-Coles; second, of Richter and, third, of Alexander, the last being a combination of Schaag and Falk. These systems, however, are not extensively worked, most manufacturers being conservative enough to adhere to the old fusion system with all its well known inconveniences and disadvantages. At a meeting of the Eisenhutte at Dusseldorf, a paper was read by O. Vogel, pointing out the true galvanic method over the old fashioned fusion method. He states that it gives a more uniform and thinner coating; which is equally efficient as a protective covering for surfaces liable to rust. There is no loss owing to the formation of dross and hard zinc, and the process is much more easily adapted to complex shapes and surfaces than the fusion method. Of course, the galvanic system has disadvantages, and Vogel thinks these may be summed up in the statement that it requires more men, more time and more intelligence. In the discussion which followed, the general consensus of opinion appears to have been that the galvanic processes are less adapted for large-scale operations than the old fusion method. The question of galvanizing telegraph wire also came up in the discussion and it was considered that the old method was the most suitable for this, because according to Schmidt, the electrolytically galvanized wire will not stand the regulation test. At the same time it would be unfair to consider that finality has been reached in the new methods, and in all probability such disadvantages as they may possess will be got rid of.

THE X RAY AND TEMPERANCE.

Hope springs eternal in the breast of Frances Willard, whose devotion to the cause of temperance, coupled with a sanguine nature, sometimes leads her to embark on a rainbow-chasing expedition. "I believe the X rays are going to do much for the temperance cause," says Miss Willard. By this means drunkards and cigarette smokers can be shown the steady deterioration in their systems which follows the practice, and seeing is believing."

Miss Willard is too enthusiastic, and it is safe to say that she will be disappointed if she expects that instantaneous photographs of the interior will induce old topers to forsake their cups, or persuade the street urchins and college boys to throw aside the cigarette. The evil effects of such indulgences are very well understood now. When the appetite for alcoholic stimulants becomes so strong that it outweighs the instinct of self-preservation, it is recognized as a symptom of disease and the victims cannot be cured simply by inviting them to look at inside and out views of victims who have preceded them on the downward path. Miss Willard is wrong in thinking that intemperance is due in any considerable degree to lack of knowledge of its evil effects; and even if she were right in this particular it would be difficult to see how the X ray could add greatly to that knowledge.—*An Exchange.*

LONDON AND THE TELEPHONE COMPANY.

An application to the National Telephone Company for permission to lay cables under certain thoroughfares in the city was considered at a meeting of the City Commissioners of Sewers last Tuesday, and it was decided to refuse the application, on the ground that the Company was not prepared to make any concession for the public benefit in return.—*The Electrician*, London.

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ELECTRO - PNEUMATIC PLANT

Combination System of Interlocking at Grand Avenue Junction of Roads in St. Louis—Perfection in Operation Allowed.

DESCRIPTION OF APPARATUS EMPLOYED.

One of the most interesting applications of electro-pneumatic interlocking apparatus yet constructed was put into service at St. Louis, Mo., Sunday, March 15th, of this year, as has already been stated in these columns. Through the courtesy of the Union Switch & Signal Company, who installed this plant, we are enabled to illustrate and describe it. Fig. 1 presents a plan of the tracks with the names of the roads concerned indicated, and showing the relative locations of the Wabash and Missouri Pacific tracks with reference to the crossing by the lines of the St. Louis and San Francisco. Fig. 2 gives an idea of the appearance of the machine taken from the front. The rear view is shown in Fig. 3, in which the wooden casing at the back of the machine was removed to show the construction and the arrangement of the indication attachments.

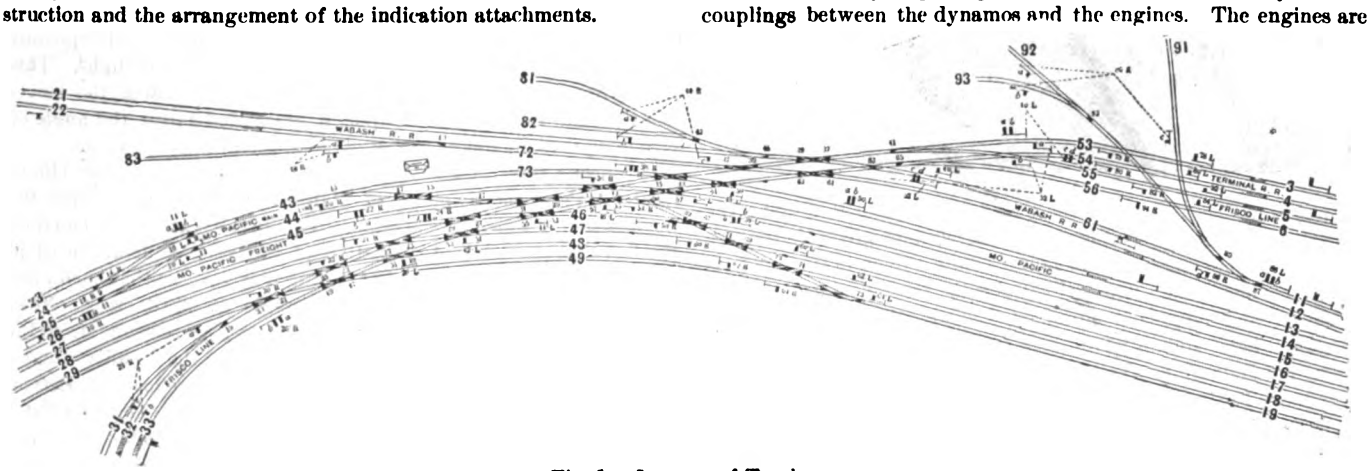

Fig. 1. Lay out of Tracks.

It is necessary only to refer to the excellent plan of the tracks in order to see that the plant is an ideal one for interlocking purposes. The designers deserve great credit for the arrangement which was finally decided upon.

The machine has 95 switch and signal levers combined, but up to the present time only 69 of these are actual working levers. There are 12 spare switch levers and 14 spare signal levers whereby a considerable extension of the plant may be made when necessary. In the old practice the top row was always used for switch levers, and the lower row for signals. The new machine, however, is so arranged that certain switches hand signals might be arranged in groups when necessary in which both the upper and the lower levers can be used for either purpose. This is found to be a great advantage as by it the size of the machine can be reduced for the reason that nearly always there are more spare signal levers than switch levers, and with the new arrangement the lower row can be utilized as switch levers and in consequence the length of the machine may be reduced, which in some cases may be advantageous.

The pneumatic machine has gone through a series of improvements and has now attained a condition which is thought to be likely to be permanent, and for this reason the machine described is provided with hardened steel bearings and wearing parts whereby its life will be increased over that of any of the older ones. The machine has a large number of improvements which will be readily understood from an examination of Figs. 2 and 3, by those who are familiar with the construction formerly used. The locking, it should be stated, is only effected by the signals except in the cases of crossings, there being no locking between switches elsewhere. The machine is capable of giving 520 different routes which is something unusual not only in this country, but also in Europe. The plan of track shows the final arrangement of signaling, but when the machine was put into service the terminal tracks were not connected consequently the signals governing it are not erected. It is expected, however, that they will be applied in the near future.

The electric current furnished for this interlocking apparatus is generated in the lower story of the tower by two Westinghouse dynamos of 50 volts at 45 amperes each. These are two independent units driven by two five-horse power Westinghouse standard engines direct connected. Pneumatic power is used for running the engines as well as for the interlocking proper and is transmitted from the air compressors at the Terminal Association's power plant at the Union Depot, a distance of over 8,000 feet, through which it is carried in a three-inch pipe. While running the engines for charging the storage batteries, as well as operating the switches in the plant, there is no perceptible drop in the pressure in the pipe, and yet there is no large storage reservoir provided at the Grand avenue end. The storage batteries used in connection with this plant are of the chloride type and have a capacity of 300 ampere hours. There are 16 accumulators in two sets of eight each which are located in a room by themselves in the lower story of the tower. These batteries are placed upon a strong wooden rack upon castors which greatly facilitates the work of renewing. The Westinghouse engines and the dynamos are mounted upon concrete foundations 5 feet in depth, and the possibility of getting out of line is taken care of by flexible couplings between the dynamos and the engines. The engines are run at a speed of 500 revolutions per minute. The current used for charging the batteries is 25 volts and about 30 amperes. The discharge is at 16 volts. An ingenious cut out is employed which was the invention of an employee of the company, which prevents the current from the batteries from running back into the dynamos in case of the air pressure running down. This device employs the principle of a volt meter which is so arranged that if the voltage runs down owing to the shutting down of the machine or the slackening of the speed due to the air pressure becoming low, the batteries are automatically cut out and when the voltage picks up again to the desired point the current is cut into the batteries again.

The outside work of the interlocking plant itself is not different from that of other electro-pneumatic plants recently constructed. Five wires are used at each switch and the improvement in the outside work consists chiefly in the arrangement of the wires according to the plan usually followed in mechanical interlocking work. The wires are cabled to each switch, and there are 60 cables leaving the tower through arches at the lower side of the wall. The experience with the electrolysis at the terminal plant has led to the protection of the entire air pipe system of the Grand avenue plant, and the main air pipe leading thereto, by covering it with five-inch sewer tile with space between the air pipe and the tile filled up solid with pitch. The main air pipe is located three feet and a half below the level of the top of rail. It is regretted that space cannot be given to more complete description of this interesting part of the work. The only change in the switch and lock movements is that the lock rods are slotted, and riveted dogs are used in place of the malleable iron fingers which were formerly bolted to the sliding bars of the movements. The boxing around the switch and lock movements is so arranged as to expose all of the bolts used in securing the timbers and each switch and lock movement is connected to the system of

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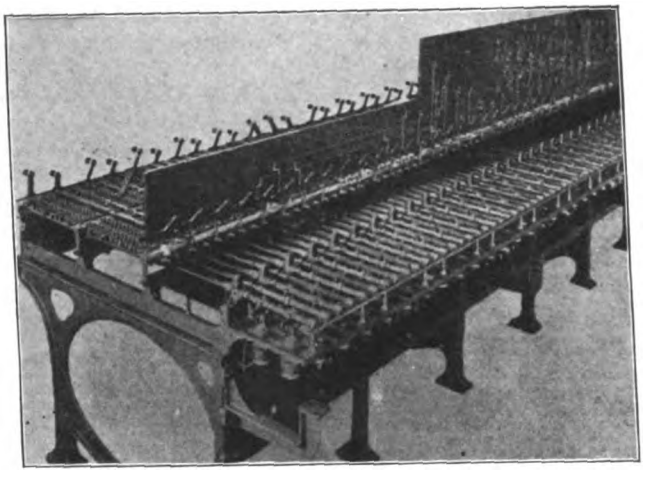
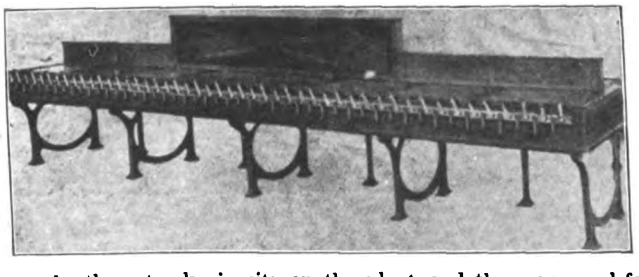
drainage at the plant. The main leads of wires are arranged with special reference to ease of drainage and access for testing and repairs. They are placed in trunking made of 2 x 8 inch tarred lumber in which they are supported upon shelves under which there is four inches of clear space for drainage. The cables are arranged in the order of the switches for easy reference in testing, and each is provided with an index wire to facilitate tracing.

There are 22 slip switches in this plant and no derails. The distant signals are located at a grade distance from the tower and around curves in such a way as to prevent the possibility of satisfactorily operating them by any but electro-pneumatic apparatus.



No change has been made in the switch valves, and it would seem that none is necessary, as it is stated that with 82 valves at the terminal plant there were but two failures among them in the first two months of operation. The distant signals are all equipped with the Spicer and Schreuder illuminated blades. The Wabash and "'Frisco" home signals have green and red lights and the Missouri Pacific red and white. The tower is of brick of two stories, the lower story having a four-inch concrete floor. A large bay window is provided in the upper story and the building is equipped with all modern conveniences. This is a plant free from what might be called frills, and as the electrical features have been very greatly simplified and the operating devices greatly improved, this would seem to be a model plant in many respects. It is much safer than those of older construction in that it is impossible for one of the operators to "plug" the indications without assistance. There



are only three track circuits on the plant, and these are used for annunciators. Telephones are provided between this and the other towers, and also between the tower and various points in the yards for the use of the yard crews in communciating with the train director. The total force for operating consists of two train directors working twelve hours each, and three levermen each working eight hours. A boy is on duty during the busy hours to receive telephone calls. The maintenance is looked after by one repairman who works days and another one who is on duty nights. There are also two lamp men. There are several other interesting features which for lack of space cannot be mentioned here.

The Card Electric Company, of Mansfield, Ohio, has increased its capital stock from $100,000 to $150,000, evidently in anticipation of good times. And then say the people of the Buckeye state are not heart and soul with the McKinley enthusiasm.

ACADEMY OF SCIENCE MEETING

Some Interesting Subjects Discussed at the Recent Washington Convention of the National Academy —Roentgen Photography Leads—Other Scientific Topics.

BY WM. H. HALE, PH. D., SPECIAL CORRESPONDENT.

The meeting of the National Academy of Sciences at Washington, April 21st to 24th, was largely attended, and brought out some very interesting papers and discussions. The most prominent feature was the X-rays which were considered at every meeting, papers on other subjects being however interspersed. The mornings sessions were devoted to business, the afternoon to papers and discussions.

The first paper by Prof. E. W. Hilgard, of California, on "The Geological Efficacy of Alkali Carbonate Solutions," was read by G. Brown Goode in the absence of the author. A paper of great interest to chemists "On the Color Relations of Atoms, Ions and Molecules," by M. Carey Lea, of Philadelphia, was read by Ira Remsen, followed by a paper on the "Characters of the Otocoelidae," by Edward D. Cope.

Professor A. M. Mayer, of the Stevens' Polytechnic Institute, occupied the rest of the afternoon. He first exhibited and explained a linkage whose motion shows the laws of refraction of light. This was an ingenious piece of mechanism, so arranged that the movement of the index showed upon a graduated circle the angle of refraction corresponding to any given angle of incident rays.

Professor Mayer then described the method employed by him to locate in Paris the dwelling of Malus in which he discovered the polarization of light by reflection. This investigation was based on the fact that the index of refraction of the glass generally used in windows at Paris in the time of Malus was 1.51, so that such glass polarizes light when reflected at an angle of 33½ degrees. Now, Malus made this discovery while examining rays reflected from the Luxembrough palace. Professor Mayer visited the locality where a line drawn at that angle by light of the setting sun reflected in December intersects what was formerly the Rue d'Eufer, and found still standing in a little triangle surrounded by three streets, the indentical dwelling which this discovery has rendered historic.

Professor Mayer then reported some experiments which prove that X-rays cannot be polarized. To investigate this question, we need some substance which shall be thin, and of low density. The substance best adapted for this purpose is herapathite (iodosulfate of quinine). This is difficult to make, but the following process is employed. Bi-sulfate of quinine is dissolved in a mixture of acetic acid and alcohol, and after heating to 140 degrees F., a sufficient quantity of the alcoholic solution of iodine is added in drops, and the mixture allowed to cool without vibration for twelve hours; thus large crystal plates are found floating on the surface. They have been obtained as this as .9, and as thick as 4½ millimetres. We can only get one-fifteenth as much of these plates as the quantity of bi-sulfate of quinine employed. These plates were exposed to the action of the X-rays for three different periods ½ hour, 1 hour, 33½ hours, they were turned at an angle of 90 degrees; also a piece of blotting-paper saturated with herapathite was exposed; but the resulting pictures showed no trace of polarization, and this experiment must be regarded as conclusive. In regard to claims advanced by some that calc-spar has a polarizing effect. Professor Mayer says that it is impossible to obtain thin enough plates of it for the rays to pass through, and no importance is attached to any of these calc-spar experiments.

The second part of this paper was on the specific gravity of herapathite, which Professor Mayer has determined with great care and finds to be 1.557, being much less than the figures given by Herapath himself.

The third part of the paper was "Formulæ of Transmission of the X-rays through glass, tourmaline and herapathite." To determine whether rays just go through or nearly go through, we use a wire grating which will appear in the picture of the rays go through. Transmission depends on the thickness and the time of exposure. Glass of various thickness is used. The eye cannot distinguish a

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less difference than about one-hundredth. Glass of the thickness of five millimetres allows one-hundredth of the incident intensity to go through. Beginning with glass of one-tenth millimetre in thickness, each additional thickness absorbs one-tenth of the rays, which have passed through the preceding. Thus the general formula becomes $I'=I\,a^t$. Substituting the equivalent of (a) we find the formula for glass $I'=I \times .92^t$, and for herapathite $I'=I \times .93.82^t$. The formula for tourmaline is exactly the same as for glass, hence tourmaline is a very imperfect substance to use.

The first paper on Wednesday, by A. A. Michelson and S. W. Stratton, was on the source of the X-rays. Professor Michelson said that the X-rays are not essentially different from those of Lenard. They produce their effect outside. The X-rays are then more penetrating, but this may well be without indicating any essential difference because the rays do vary greatly in other respects; for example some are more deflected by a magnet than others. The cathode rays are different from both these. They start in a direction nearly normal to the equi-potential surface, and proceed thence to the straight lines. The X-rays do not. The X-rays eminate from the first surface encountered by the cathode rays. The speaker stated that he did not agree with Professor Rowland, who maintains that the rays originate from cathode rays falling on the anode.

Professor Michelson's experiments were made with a tube small at one end and large at the other like a bell. Over the large end was a plate of aluminum with a disc ground very thin in the middle. The electric current was turned on for twenty or thirty minutes, while a photographic plate was exposed at the distance of three-quarter of an inch from the aluminum. In one experiment, the small end of the tube was the anode and the large end the cathode; in another these were reversed, and on the third the anode was a wire introduced in the middle of the lower part of the tube, and having the end which was within the tube protected by glass, while the aluminum disc was the cathode. In the first experiment the picture of the disc was a diffuse image without definite boundary, but sharper when the plate was near the disc; in the second the picture had well defined outlines, not much larger than the disc, and was evidently a shadow of the disc. The third experiment gave profuse rays and a dark picture. This goes to show, therefore, that the source of the X-rays is wherever the cathode rays strike.

In discussing the paper, Professor Rowland described an experiment which seemed to show that the rays all come from the anode, and nearly all from the point of it, not from a diffuse point, as if where the cathode rays strike, but sharp so that one-thousandth of an inch more than covered the edge of the shadow. He also reported that greater effect was obtained when the cathode was ground to a reflecting surface and focused on the anode. Professor William A. Rogers said that good results were obtained by grinding the glass at cathode end of tube so as to reflect rays to a focus. Professor Rood remarked that some of his work had been interfered with by the appearance of electrical lines on the plate. As X-rays can discharge on electrical surface, he suspects that the electrical surface can dicharge the X-rays. Professor Arthur W. Wright remarked that the cathode is not directly the source of the rays in their entirety. Some originate there, but not all nor a considerable proportion. A surface on which the cathode rays strike is a source, perhaps not the only source.

Professor T. J. J. See, of Chicago, read a paper on "Results of Researches on Forty Binary Stars." He has been making observations for three years. It is not 115 years since the first double star was discovered, and we now know only forty accurately. There is no evidence of disturbing bodies except in a few indecisive cases. The law of eccentricity of their orbits is that they average twelve times as much as the planets. The law of gravitation is rendered probable, and may hereafter be confirmed by spectroscopy. Professor See gave a very full table of results (sent by previous mail).

A biographical memoir of James Edward Oliver was read by Professor George W. Hill.

A biographical memoir of Charles Henry Davis, prepared by C. H. Davis, was read by the secretary, Professor Asaph Hall.

Professor William A. Rogers read a paper prepared by himself and E. W. Morley on the "Determination of the Coefficient of Expansion of Jessop's Steel, Between the Limits of O degree and 64 degrees C. by the Interferential Method." This coefficient is 10.48.

Professor Rogers also read a paper on the "Separate Measurement by the Interferential Method of the Heating Effect of Pure Radiations and of an Envelope of Heated Air."

Professor Ogden N. Rood read a paper on "Experiments on the Reflection of the X-Rays." The source of the rays was a fluorescent shell in a vacuum tube. A sheet of platinum foil about seven inches square was so arranged as to reflect the rays upward at an angle of 45 degrees. A sheet of lead above cut off the direct radiation from the shell, and allowed the reflected rays to strike a plate holder which was enclosed in aluminum one-hundredth of an inch thick, so that no light could pass through. This was covered by a wire grating and the plate was exposed for ten hours. The plate holder was then removed and stripped of its aluminum, so that light could enter. Another plate was inserted, and the holder returned to position. A light was put in place of the vacuum bulb and one or two flashes made. Identical pictures were made by the X-rays and the flashes of light, thus proving that the rays obey the same law as light. Even the blurred appearance of perpendicular lines, caused by reflection from the platinum foil which had been rolled, and consequently creased, appeared the same in both pictures. The amount of reflection was one-two hundred and sixtieth part of the incident rays.

In discussing the paper, Professor Mayer said that these experiments give absolute proof of reflection, and are the only addition yet made to Rœntgen's original discovery.

Professor Henry A. Rowland read some notes on the X-rays. He had tried to reflect them from steel mirror, but without result; probably he said because he did not take so much care as Professor Rood. He then tried to refract them through a double fusion of aluminum, but also without result. A wire was so arranged above the fusions that any refraction would have made a bend in the image of the wire.

As to the source of the rays, Prof. Rowland thought that many of the experiments were inconclusive because of oscillations of the current, which usually make each pole alternately anode and cathode. He concludes from his own experiments, carefully guarded against these oscillations that the anode is the principle source, but it seems to be necessary for cathode rays to fall on the anode. When these rays fall on any part of the glass, they convert that in some measure into an anode. They have reached the same conclusion in England, making focus tubes, in which the cathode is ground to focus on the anode. Prof. Rowland has secured powerful results from perfect vacuum tube shaving electrodes within a millimeter of each other. The source of the rays here is less than one thousandth inch; and the width of the image gives a wave length not greater than one-eighth inch the length of yellow light, which is shorter than any light waves. We can get light waves one-fourth to one-fifth of yellow light *in vacuo*, but in air these short waves are soon absorbed. Similarly in fluids, hence it is very difficult to get a blue fluid.

As to the nature of the rays, Are they longitudinal vibrations in elther? We dont know. Clerk Maxwell attempted to demonstrate that there could be no such vibrations, but his demonstration required certain unauthorized assumptions. It almost seems as if we had no wave theory applicable to these rays.

Are they then matter? This is doubtful. Michelson suggests that they are whirls in ether, and this may be so.

It seems as if particles of matter are shot out in the vacuum tubes, and something keeps on, I wont say what.

A biographical memoir of George Englemann was read.

The election of new members was held to day and the only persons elected were Charles D. Walcott, director of the United States Geological survey, and Robert S. Woodward, of New York city.

FOURTH DAY.

A paper on "Legislation Relating to Standards," by T. C. Mendenhall, was read by title, Porf. Mendenhall and several others interviewed the senate committee on finance to urge adoption of the bill relating to the metric system.

Prof. Ira Remsen read a paper on "Some Studies in Chemical Equilibrium," also read by title two other chemical papers.

Prof. A. E. Verrill read some papers on molluscs.

Prof. Arthur W. Wright read a paper on "The Relative Perme-

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ability of Magnesium and Aluminum to the X-Rays. "He noticed that a strip of magnesium two millimetres thick seemed very transparent when making a picture. He then hammered out a plate 1,324 mm thick from a cylinder. He also prepared a wedge of aluminum papering from 2.75 to 2 mm. placing strips of magnesium on each side for comparison, and found the latter much more permeable. At the thickness of .63 mm. it only cut off half as many rays as the magnesium. He also made other experiments which confirm these results that magnesium is much more transparent than aluminum. This is a discovery of great practical value, because it enables us to use thinner metal in experiments with the X-rays. Also it is much easier to work magnesium than aluminum because it softens with heat and can be beaten out and molded. It has remarkable metalurgical properties. Shavings of it when heated in the air take fire and burn, that is they unite with oxygen; but larger masses become covered over with a black coating of nitride of magnesium, underneath which the metal is soft, perhaps even melted. The formula representing the transparency of the two metals shows that the relative quantity of rays transmitted by plates of different thickness is variable; so that, while magnesium of a certain thickness will transmit twice as many rays as the same thickness of alluminum, this proportion does not hold for other thicknesses.

Prof. Othniel C. March read the last paper On the "Pithecanthropus erectus, "discovered last year in Java. This is an animal nearly, but not quite man, the missing link. The fossils were found in stratified rock of the pliocene epoch on the banks of a river. This carries back the origin of man like animals much further than was hitherto supposed, and locates them in a new part of the world; hence the great importance of the discovery.

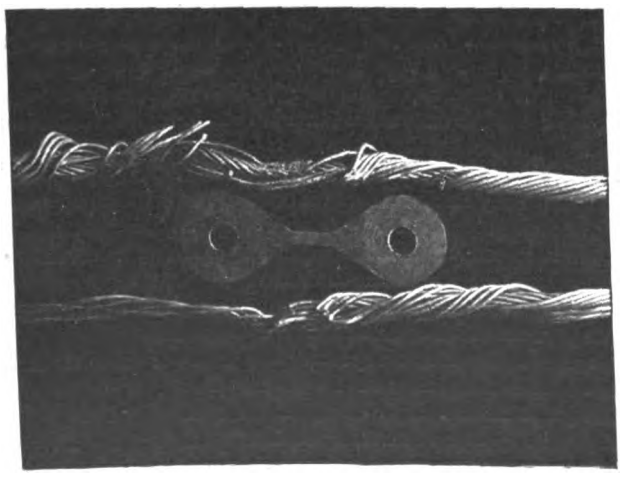
Several more papers were read by title.

The Academy adjourned to meet in New York city, Nov. 17, 1896.

A "BAD FUSE" FIRE.

A fire occurred in Chicago on the 20th of April at an iron cornice of the Annex building of the Illinois Central Railway Company at 12th street and Park Row. Pierce and Richardson after a careful examination, pronounced the cause electrieal and the accompanying cut is illustrative of the fact that electricity had been at mischief.

At the particular point where the fire is supposed to have originated four 0000 rubber covered cables and two No. 12



Safety rubber-covered wires entered an opening about four by nine inches through the iron cornice to a large bracket on which were placed porcelain insulators, and from there to a pole. There was a separation of an air space around the wires and they were additionally protected by tubing, but either because of the settling or vibration of the building the wires were injured by the edge of the cornice. It is interesting to note the fuse protection on the small as well as the larger wires; the two small wires were supplying current for two arc lamps probably consuming at no time more than ten amperes; one was attached to a No. 6 wire which in turn was attached direct to a 4-0; the other was attached to a short length of ordinary No. 14 flexible cord which in turn was attached to a No. 6 wire and the latter to a No. 4-0.

The large cables were protected on the switchboard in the dynamo room by copper strips as illustrated in the cut. The thickness of the strips is twenty-three mils and the narrowest point measures 290 mils. There is not the least doubt but that these strips would carry current sufficient to burn off a cable of 500,000 c. m. with any except an absolute short circuit.

The plant which was installed three years ago by the Brush Company, the wiring for which was done by the Chicago Edison Company, was pronounced a model one.

This fire was due to the use of a copper bar fuse, shown in the cut, and furnishes a new lesson anent the unreliability of fuses of any sort, and shows the growing necessity of circuit breakers instead.

ELECTRICITY CARRYING DOUBLE.

Admirable Installation for Light and Power at Middletown-Bicycle Factory Operation.

One of the most interesting modern stations in this country, and the first, perhaps, which has a larger motor load than a lighting load is that at Middletown, Ohio, operated by the Middletown Electric Light and Power Company.

It is now some four months since Mr. F. H. McKnight, President and General Manager, determined on an increase in his station, which up to that time had operated on a small scale only. The conditions with which he was confronted showed the necessity for a system of distribution which would allow him to cope with a large demand for current for motor service during the day and a similarly large one for lighting after dark. As best satisfying these conditions, Mr. McKnight selected the Monocyclic system of the General Electric Company.

The power house is large and well ventilated, and is situated near the center of the city in an ideal location for an electric station. It fronts on the Cleveland and Cincinnati Canal, while immediately behind it are the tracks of the Michigan and Central Railroad. Water for the station is taken from the canal in front, and the necessary coal is shoveled directly into the bins from the cars standing on the tracks behind.

The steam equipment consists of two Brownell & Dayton boilers furnishing steam to one 250 H. P., Russell Engine, and one 100 H. P., Ball Engine. The first runs at 164 revolutions, and drives from a counter shaft the new Monocyclic generator and two T. H. 75 light arc dynamos; the latter runs at 285 revolutions and drives a D. 62 T. H. bipolar direct current low voltage machine. The Monocyclic generator is a standard 12 pole machine, running at 600 revolutions. It is rated at 150 K. W., at 1,040 volts, and is excited by a 12 K. W. exciter. The D. 62 furnishes current for direct current motors scattered throughout the city. The arc machines operate lights in the streets, while the Monocyclic is wired for about 180 H. P. in motors and 2,000 lights. If all the lights and motors were operated at the same time the total amount of energy required from this generator would be about double its capacity, and its power to cope with the conditions illustrates forcibly the advantages of the Monocyclic system. During the day the lights burning are comparatively few, while the motor load is at its maximum. This condition is reversed after dark, when the motor load drops off and the lighting load rises in turn. The generator which runs 23 hours per day, is worked continuously at its highest efficiency and satisfactorily fulfills its double duty without sparking or noticeable heating.

With service of this severity, deterioration in the performance of the machine would naturally be expected. Yet it has been running for about three months under these onerous conditions without a minute of lost time from any cause whatsoever.

The regulation of the machine is noteworthy, the voltage remaining almost absolutely constant. The lights at a large factory, about a mile away, and those throughout the city burn with equal brilliancy and the throwing on or off of the motor load is accomplished without flickering or variation of the intensity of the light.

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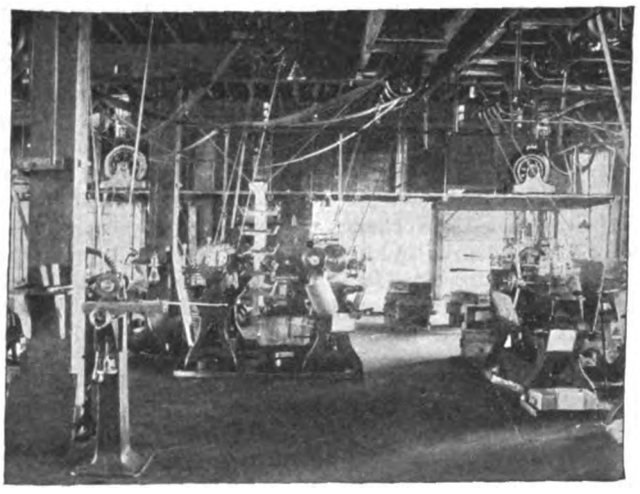
In fact, the presence of the motor load is usually only determined by examination of the ammeter. This perfection of regulation is attained by placing the stationary shunt of the alternator in a certain position in the morning, and leaving it thus during the day, while the induction motor load dominates. At night when the lighting load is the heavier, the only change necessary is the advancing of the stationary shunt about one inch. No care beyond this is needed to maintain a constant potential—the machine apparently takes care of itself.

The most important client of the Middletown station is the Miami Cycle and Manufacturing Company, whose factory is located about one mile distant. It takes current for 180 H. P. in motors; for 800 incandescent lamps of which 400 are usually in use and for six arc lamps. The Cycle Company turns out about 200 wheels a day, and employs from 500 to 600 hands. It manufactures an extremely high-grade bicycle, and acknowledges the assistance to this end which electric service renders.

The current is transmitted from the station to the works over two mains and a teaser wire at about 1,000 volts, and is reduced to



about 115 volts in six 30,000 Watt oil cooled transformers installed in a small house erected in the angle of the L-shaped main building. All the motors derive their supply of current from these transformers connected in multiple. The lighting circuits are taken off from two 7,500 and one 15,000 Watt transformers. The primary wires from the station are passed through a station Watt meter just before they arrive at the transformers, and thus the consumption of energy in both lighting and motor circuits is measured in one instrument.

The secondaries run from the small sub-station north and south to the motors and lights in the two legs of the L. These running south operate in the machine shop three 20 H. P. motors, each bolted to a long line of shafting from which run 80 belts. One of these motors is used to drive 15 lathes, 4 sharpers and 6 milling machines, 3 water emery wheels, 1 planer, 1 die sinker, 2 universal grinders, 2 gear cutters and 2 drill binders. The other two operate 35 screw machines; 1 oil separator, 1 oil pump and 2 high-pressure blowers giving air to the forges in the smithy.

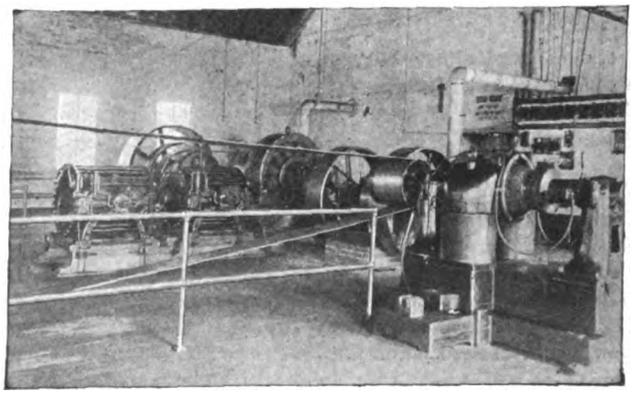
The feeders running north supply energy to three 30 H. P. motors, two of 10 H. P. and two of 5 H. P. One of the 10 H. P. motors is in the drill room, and runs a shaft from which belts run to 12 large and 3 small drill presses, 2 cone grinders and 4 small milling machines. In addition it operates 1 band saw, 1 circular saw and 1 wood turner's lathe in the pattern room adjoining. The other 10 H. P. motor is in the frame making department, and drives three large punch presses for the manufacture of handle bars, seat posts, etc., 3 large drill presses, 4 small ones, 2 frame assembling tables, 3 small milling machines, 2 emery grinders, 1 swaging machine, 4 stock machines, 2 tooth cutters and 1 double polishing lathe.

A large portion of the power which comes into the factory is used in the polishing room where 35 double polishing lathes run incessantly. These are operated at present by two 30 H. P. motors. The remaining 30 H. P. motor in the north section drives a 48-inch exhaust blower which carries away the dust from the polishing room.

Located in the assemblying department is a 5 H. P. motor which operates a freight elevator of 1,500 pounds at 60 feet per minute capacity which runs up and down through the room. When this was put up it was thought that a larger motor would be required to move up and down the occasional heavy loads, but the 5 H. P. motor not only operates the elevator satisfactorily, but also has sufficient power left to drive five small drill presses. The other 5 H. P. motor drives a 4 K.W., C. and C. generator used for plating purposes.

All these motors are of the General Electric induction type, without commutator, collector, or moving contacts. They are set up on platforms swung from rafters in the rooms, an arrangement rendered possible by the fact that they require no attention beyond an occasional oiling, and thus occupy no floor space whatsoever.

The introduction of the induction motors into these works was the result of pure conversion. Skeptical at first, the company, willing enough to allow a trial, permitted the installation of a 20 H. P. motor as an experiment. It reached the factory in September, 1895, was put into service in the machine room, and ran the machine for the night shift. The experiment was as severe a test as could well be imagined for a motor. It ran over 300 feet of 3-inch shafting, 172 belts, 5 screw machines and 17 other machines such as drills, lathes, etc. The usual course was to add machine after machine until the motor stopped. One or two would then be thrown off and under an excessive overload which brought it within the reach of breaking down the motor continued to run for its shift of ten or twelve hours. No accident happened to it during the two months this course of treatment continued. Its missionary work was successful. It was purchased by the Cycle Company, which ordered eight others at once, to be sent by express. Their factory could not be equipped electrically too soon for them. The constant speed of the machinery has enabled them to turn out a wheel with workmanship of peculiarly high quality, and its success has compelled them to enlarge the works, which are entirely lighted with lamps taking current from the Monocyclic generator.



In addition to the load at the Miami Cycle works, the Monocyclic generator supplies current to 500 to 600 lights throughout the town, and 650 incandescents in the Sorg Opera House. With 50 H. P. in motors and 400 lamps burning at the cycle works, and as many in the city, the lights in the Opera House burned brightly and without flickering.

The description of this noteworthy plant, the success of which is due to the able management of Mr. McKnight, may fitly be concluded with his own remark: "In all particulars it surpassed my most sanguine expectations."

BRITISH CABLE TO WEST INDIES.

In the House of Commons last week Mr. Chamberlain, in answer to a question from Mr. Tomlinson, said he had received communications from the West India Colonies, representing the importance of establishing a through telegraph communication between this country and those colonies, for the purpose of Imperial defence, as well as for commercial purposes. He had no reason to think that there are any insuperable difficulties in effecting any such communication, and proposals on the subject were under consideration, which he hoped would result in a cable being laid at no distant date.—*The Electrician*, London.

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President Wilmerding's Address.

President C. H. Wilmerding's address, delivered at the opening of the New York Exhibition, presents two facts that should be applauded on this side the Atlantic, namely: that a single one of the large central stations in this country has a greater electrical output than the combined capacity of the generators of Paris; and that while there are fewer than 100 electric railways in all Europe, there are more than nine times as many in the United States alone.

To those who have not closely followed the crowding events of the past few years in the commercial world, this clause of Mr. Wilmerding's address will come as a revelation: "The electric railway is of still more recent birth, dating back but ten years, and yet at the present time there are no less than nine hundred such roads in this country, using eleven thousand miles of track, operating twenty-five thousand cars and involving an investment of about seven hundred and fifty millions of dollars, and this investment is increasing annually at the rate of one hundred millions for new roads and new equipment. While these are large figures, they do not at all represent the total capital employed in electrical industries. The manufacturers of the apparatus and supplies used to carry on this enormous business and the dealers who handle them have to stake probably a sum sufficient to build and equip all the central station plants in the country; and if the auxiliary enterprises, such as those of the producers of copper, the makers of boilers, the engine and car builders, fixture manufacturers, glass workers and a score of others who depend in a large degree and in some cases exclusively upon the electrical trade, are considered, the grand total would reach a sum that any country might be proud of as a National debt" Truly this is the electrical era and American genius and pluck and daring have brought it about.

A Study of Isolated Nerve.

We produce, in another column, an abstract of a lecture on "A Study of Isolated Nerve," recently delivered before the Royal Society at London, by Augustus D. Waller, M. D., F. R. S. We must first plead guilty of having borrowed the abstract from our contemporary, *The Electrician*, our only excuse being that the original paper was not at our hand.

We must assume, of course, in considering such an abstract as this, that the matter has lost somewhat, by reason of a probable unfamiliarity with the subject on the part of the journalist who undertook the task of curtailing. But after making due allowance in this regard, we are still constrained to ask the question, why was so much time and labor and thought given to a task that could prove of no value whatever? Mr. Waller must be quite aware that it will make no difference to the electrophysiologist what the action of a direct current on "isolated" nerve will be. He does not care what its contractility, or excitability is—when separated from the living subject. All this has been covered by physiologists, in the way of frog vivisection during the past twenty-five years, more or less. What we want to know now, and what we must know, if we are to progress, is what is the physiological action of various currents on living tissue while that tissue is either normally or abnormally performing a vital function. Of course we are aware of the difficulties to be overcome—the hopelessness of acting in any degree upon a given section of tissue while it is yet in normal site without extending in some measure the action to adjacent territory. We are aware of the obstasles to be overcome before we may analyze effects on living, active tissue. Our chemical reagents are not to be applied under such conditions, nor is our microscope to be relied on to tell the story of metamorphosis or protoplasmic readjustment—and even if we were able to read these changes, the limits of our present knowledge of physiology would bring us up with a jerk, when it came to a study of comparisons.

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We Accept Congratulations.

The biogrnphy and in insert portrait of Charles J. Van Depoele in our last issue attracted more attention and a greater amount of favorable comment than we had dared to hope for, though we were fully aware of the high respect and affection for the lamented inventor in a wider circle than usually falls to the lot of men. We recognize that the letters of congratulation we have been receiving are due to the estimation in which he was held, and a feeling that we had touched a responsive chord. Professor F. B. Badt, who was associated at one time with Van Depoele, desires to correct Mr. Jannus as to the place at which Van Depoele was working when his fatal illness came upon him. Professor Badt says it was at Rock Island, Ill., rather than at Block Island, Minn. We assume that Mr. Jannus will not object to the correction, as Professor Badt says he was in charge of the work at the time.

After all the excitement, it has been shown that the story of an Iowa farmer having invented a *ray* that would change 13 cents worth of silver into $153 worth of gold, comes from the camp of the free silverites. They evidently concluded that if they could show how a bagatelle of silver could be turned into a bag of gold, people would want the silver free. But the principle will never be popular until they go further, and show how the bag of gold can be turned into our pockets.

Rev. Dr. Mitchell, of Kansas City, is said by the local newspapers to have discarded his electric bells and now uses an Alpine horn to wake his janitor. No statement is made as to what the horn contains. Perhaps a bichromate solution to generate electricity for the bells. A *horn* properly equipped has been known to generate so much electricity that it took ice to the head to subdue the effects.

The Chicago connections of the Calumet Electric Street Railway have all been completed, and the road has now about 80 miles of tracks. At the annual meeting, a few days ago, the capital stock of the company was increased to $5,000,000.

Those who do not yet admit the vast influence of electricity in the affairs of this country will be enlightened on application to Mein Herr Burger of Milwaukee, who is walking down town these pleasant days because of the strike of the railway motormen.

Electricity and politics may not mix very well, but just the same Brother Hamill's alchemy is good enough for us. "McKinley and protection" would do more for the electrical interests of this country than all the combines ever hatched.

A new prescription for cholera, tuberculosis, diphtheria, typhus, etc.: take all the bacilli from the afflicted person, place them in a test tube and turn on an X-ray. Wait two weeks to see if they are dead, and if not, issue another bulletin, and try again.

One of the exhibits at the New York electrical exhibition, that is attracting more than a usual share of attention is the Morton presidential lightning rod. It is unique in that it is a non-conductor.

An electric car killed a little boy on North Clark street, Chicago, a few days ago. The motorman and conductor were locked up on the charge of *assault*. A few hours later an employe of the road gave bail in the sum of $5,000 each and they were released. Why assault? Should it not have been either *manslaughter*, or a deplorable but unavoidable accident? Things are called by queer names sometimes, in this enlightened age.

S. M. HAMILL.

The subject of this sketch needs no introduction to the electrical people either of this country or Europe. Everybody knows him, and most people know him well enough to tell a good story about him. Sometimes the story is "a horse" on him, but mostly he will be found on the horse. Everyone knows in a general way that Mr. Hamill glides through life on "flowery beds of ease," but only a few know why, and the reason is told here for the first time—if it is betraying a secret nostrum, we can only plead that the world at large is entitled to a free and unlimited use of the information at 16 to 1 ratio. Some years ago, as soon as Mr. Hamill got through Princeton College, when he had fewer eye teeth than he has now, he resolved to go to work. That's half the secret of his subsequent success in life; the other half is that he finally learned better, and then resolved to let the other fellow go to work Before he resolved this last resolve, however, he became possessed—honestly or otherwise—of what has come to be known all over the land as "Hamill's get there stroke." For the rest, he is now general manager of the Brush Electric Company, and either president or secretary—always with a nice luscious quid-pro-quo attachment, of a large number of lighting and power companies throughout the country.

Mr. Hamill was born in Largeville, N. J. Just when we do not know, but competitors in the electrical business will agree that it was not yesterday. His young "idea" was first taught to shoot at the local school, and afterwards at Princeton College, where he was graduated with the degree of B. A. in 1880. He has since acquired from his alma mater some more of the alphabet, notably A. M. He afterwards taught school at Largeville, but he did not teach all he knew. It was after three years of pedagogy that the magic resolution was taken to go to work. He did so at East St. Louis, checking freight for the C. B. & Q. road. Field work was never to his taste, and it was not long before he concluded that he was too far from the base of supplies, so he secured a position in the paymaster's office of the same road, and a little later got still nearer the "foundation" by going into the office of the vice president at Chicago. In 1886 he was given charge of the large grain elevaters at Peoria, Ill. It was at this time that he made the second magic resolve and proceeded to execute it by going into the electrical business. He declined an offer to take the management of Swan Lamp Company, but became instead assistant secretary of the Brush Electric Company. In 1889 he became secretary of the company and moved to New York to assume charge of its Eastern business. In 1892 he was elected a director in the Company and general manager with headquarters at Cleveland.

Mr. Hamill was one of the founders of the Ivy Club of Princeton, and is a member of the University Club of New York, and the University and Country Clubs of Cleveland, In religion he is a McKinley man, with "no quarter"—at least no silver quarter—as his rallying cry.

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THE STORAGE BATTERY.

OBJECT OF THE EXPERIMENT.

The National School of Electricity about March 20th, purchased a battery (12 cells) of "Bradbury-Stone" accumulators. My work was to install these cells for laboratory uses and to acquire practical experience with this source of electrical power.

APPARATUS.

The apparatus used was: voltmeter, ammeter, hydrometer, *bolts, nuts and washers for cell connections*, porcelain insulators, Nos. 14 and 16 copper wire with double insulation, switchboard, and water rheostat.

Water rheostat. This consisted of an ordinary wooden bucket filled with water and containing two cast zinc electrodes. When connected in series with the battery, this rheostat regulated the current. To increase the current, salt was added to the water in the bucket, or the electrodes were moved nearer each other. To decrease the current, part of the salt solution was siphoned out and fresh water added, or the electrodes were moved farther apart. The aim was to preserve a constant rate of current; it was difficult to do this, as the water heated and the resistance changed with change of heat. Comparative steadiness of current was finally attained by allowing the water to become boiling hot and remain so. To avoid possibility of short circuiting, a wooden partition was placed between the electrodes; this partition was first perforated with auger-holes, to reduce its electrical resistance.

Hydrometer. This is a glass instrument similar in appearance, to a thermometer, but is not mounted. (See cut) The use of the hydrometer is to measure the density of substances, especially liquid substances. "Density" signifies the same as "specific gravity," i. e., the weight of a substance, compared to the weight of pure water (bulk for bulk). The bulb of the hydrometer is filled with mercury or with shot. This weight keeps the instrument upright when immersed in a liquid. The long tube contains a scale, or more than one scale, printed on paper; the scale can thus be read through the tube. The instrument is sealed and consequently floats when immersed. The tube sticks up above the surface of the liquid; if the liquid is very dense the tube sticks out of the liquid, so that the surface of the liquid touches the scale at a point which reads a high density. The density, whether high or low, is read directly off the scale, at a point where the stem touches the surface of the liquid. For convenience, the density of pure water is called 1.000 or 1000, and the scale is arranged on this basis. Thus a scale reading at 1100 or 1.100 indicates that the density of the tested liquid is to the density of distilled water as 1100 is to 1000, or, in other words, that this liquid weighs 1 1 10 times as much as an equal quantity of water. The Baume scale runs from zero to 72, and zero on the Baume scale is equivalent to 1000 on the scale above mentioned. The hydrometer used was furnished with both scales.

HYDROMETER.

HISTORY, PRINCIPLE AND MAKE-UP OF STORAGE CELLS.

The discovery of the principle of storage cells, or accumulators, dates from 1801 A. D., and is attributed to Gautherat (pronounced Go-tro). He noticed that if an electric current was passed for some time through an electrolyte between two electrodes, each of the same metal, a current of reverse direction could be obtained after the charging current ceased, if the two electrodes were electrically joined. He appears to have escaped much credit for the discovery which lay fallow until, more than half a century later, another Frenchman, Gaston Plante, a chemist and enthusiastic scientist, took up the matter. He experimented with different metals, and whereas previous experimenters had failed by using salt solution, Plante succeeded by using acid solution. This occurred in 1859 A. D. He ascertained, by much careful study and painstaking detail, that lead electrodes yielded the most profitable results of any metal, and that dilute sulphuric acid was the desirable electrolyte. His conclusions as to these two vital points have never been disproved, though following inventors have tried desperately to disprove them.

Plante noted that after passing current through his sheet lead electrodes for some hours, the plate from which the current passed (through the liquid) was oxidized on its surface. He then sent the current the other way through the cell and this oxidized the surface of the other electrode. By thus see-sawing the current back and forth through the cell, and giving the cell long rests between times, Plante could, in six months time, get a respectable depth of oxidation on his lead electrodes. It is upon this oxidation that the whole result depends, because to charge a cell is to transfer oxygen from one electrode to the other; to discharge a cell is to transfer the oxygen back again from the other plate to the one. Plante speculated on the causes of the phenomena and the chemical reactions; he experimented with his batteries persistently and went so far as to rig up 800 cells in series, obtaining over 1600 volts, which was pretty high tension for his day. However, he could not dig out any idea to make his battery generally useful. It depended on oxidation, lots of it, quickly obtained. Plante died without seeing what must have been the desire of his heart. Twenty-one years more the storage cell slept the sleep of commercial failure. Now a storage cell does not, so far as we know, store electricity. It stores up chemicals, first tearing them forcibly apart. These chemicals seem to like each other's company, for they sieze the first opportunity to hustle back with great energy into the married state. Electrical work or energy had to be expended to separate these chemicals. The chemicals have to expend energy to become re-united. The energy so expended appears in the form of electrical energy—energy is transformable.

In 1880 arose a new storage-cell king who reigned in place of Plante. He began to transform mental energy into tangible results. He said: "Since it is a matter of chemistry, and I want lead oxide, I'll make it chemically or buy it. I want it to stand up and it is a powder; I'll wet it down with sulphuric acid, and make paste; I'll make Plante's plates thicker and punch them full of holes; then I'll paste the paste into the holes and the powder will stand up. Then I'll pursue Plante's plan of charging and discharging." He did it. It proved practicable. He produced Plante's results and did not take six months to do it. He was a modern man. His name was Camille Faure (pronounced Fore). His patents proved valuable. His cells began to be used; but he had troubles of his own. The paste would fall out and short-circuit his plates; the paste and plates would not expand equally when heated by chemical action, so the plates warped and 'buckled" and short-circuited again. Besides the weight was very great and the price was too steep for any great *popular* success. The "pasted" plate has sometimes been made with minium (red lead Pb_3O_4) on both plates; sometimes litharge, (lead monoxide Pb O) has been used on one plate and minium on the other—but—after the charging and discharging process (called "forming") the result was the same in both cases and the same as produced by Plante. These results were: after charge, lead peroxide (Pb O) on positive plate and spongy (i. e., finely divided) lead on negative plate. The plates then chemically different, would show a difference of electric pressure and give a discharge of electric current if electrically connected. After discharge, the results were: lead monoxide (Pb O) on both plates. The plates then having no chemical difference, showed upon test no difference of electric pressure and would not develop any electric current, but were inert until again charged. Up to the present time (16 years after Faure's bright idea) no new principle has been evoked. Eager efforts to overcome the faults of Faure's cell have resulted in numerous devices and patents and in some substantial improvements. The most important of these is again to be credited

Paper read before the National Electrical Association on May 7th, 1896, by Mr. A. C. Pitkin, of The National School of Electricity.

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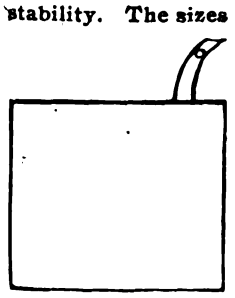
to France in the person of Clement Payen; his invention is the "chloride accumulator." It is not an accumulation of chloride. It takes its name from the chlorides of lead and zinc which are melted together to be moulded into lozenge-shaped tablets. These tablets are incased in lead plates by pouring melted lead around their edges. Then, by a chemical process, all the zinc chloride and all the chloride of lead is extracted from the lozenges. This leaves the lozenges made of spongy pure lead and the negative plates are ready for business. Some of these plates are then taken and subjected to a heavy current until "formed' and these are used as positive plates. The power obtained from the best storage cells is now claimed to be 85 per cent. of the power used to charge them. A great deal more power can be obtained from a cell of the same weight than formerly. Much less trouble is experienced from "buckling" and from formation of lead sulphate which latter was a serious fault. Cells last longer and the prices are much lower. Litigation which held back development has been settled. The principal patents have fallen into energetic hands. It looks as though the storage cell is about to show that it had again awakened from a periodic torpor. It is coming into use for propelling vehicles of pleasure, street cars, omnibuses, launches, small motors for sewing machines, fans, phonographs, medical purposes, telegraph current, telephone current, fire alarms, railway signals, plating, train lighting, lighting houses, hotels and public buildings, regulating central power plants, transforming high pressures to low pressures, smoothing the load in central lighting plants, running elevators, and doubtless will continue to find its way, like the "new woman," into avenues where no one ever expected to see it, but where its good qualiites shall secure for it, first doubtful tolerance, and then a welcome.

APPEARANCE OF CELLS.

Two plates will make a cell, but usually several plates are inclosed in one jar. The jar may be of glass, hard rubber, lead-lined wood, or any acid-proof non-conductor of suitable stability. The sizes of the plates vary from 3 inches square for small cells, 6 inches by 7 inches for medium, up to very large sizes for heavy special work. The thickness of medium size plates is about ¼ inch. The shapes of plates are usually square or rectangular—see diagram. A lug, or ear, projects from the top edge for making connections to other cells and other plates in the same cell. Plates stand upright and are placed side by side so that each positive plate is next neighbor to a negative plate. The positive plates are electrically joined together by the lugs. The negative plates are electrically joined together by the lugs. Thus all the positive plates within a cell, act together as one big positive plate and all the negative plates within a cell act together as one big negative plate.



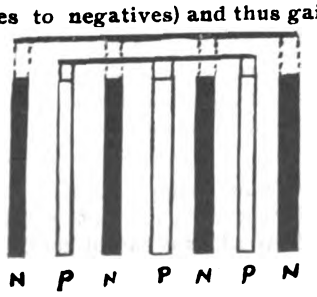
Shape of Plates.

Any number of *cells* could also be connected together on the same principle, giving the equivalent of two very large plates with the pressure of two plates *i. e.*, about 2 volts. The usual method, however, is to connect individual cells together "in series" (positives to negatives) and thus gain a considerable pressure, equal to the sum of the pressures of the cells so connected.

The connections within each cell are shown in diagram.

The appearance of plates ready connected to be put in the jar is shown by cut.

The connections for switchboard used are shown in diagram.

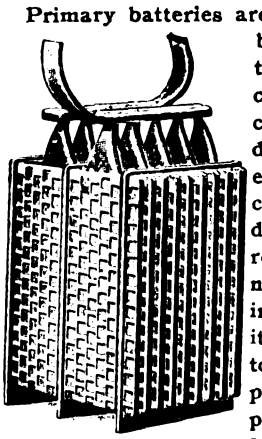


Connections of Plates.

MANNER OF CHARGING CELLS.

To charge a battery or cell, the positive end of the charging source is connected to the positive battery or cell terminal, and the negative end of the charging source to the negative battery or cell terminal. The current, on charge, thus *always* flows through the cell in *opposite* direction to the flow of current on discharge. The amount of pressure necessary to charge storage batteries is a pressure sufficient to overcome the small *resistance proper* of the plates and to overcome also the opposing *pressure* of the plates. In a rough way, it may be calculated that it needs 2½ volts pressure for each cell in order to charge a battery of cells connected in series—for example 25 volts for 10 cells (10 x 2½ volts=25 volts). Of course a variable resistance and an ammeter should always be placed in series with the charging current before beginning the charge. The voltage and current may then be adjusted until the current reaches one-tenth of the cell's capacity — that is the normal rate of charge—e. q., 1-10 of 150 amperes, is 15 amperes, which would be the proper current to use in charging a cell of 150 ampere hours capacity. If the cell had 20 ampere hours capacity then 1-10th of 20, or 2 amperes, would be the right rate of charge for that cell, or for any number of such cells connected in series.

Primary batteries are sometimes used to charge storage batteries (called also secondary batteries)—but only for small supplies of current. A handy, cheap supply of current for storage cells is needed, so devised that any person who can engineer a kerosene lamp can switch charging current on or off without danger to the battery. Direct current must be used for charging—alternate current will not do, since flowing back and forth through the cell, it would tend rather to discharge than to charge the cell. On charge, the pressure rises. At full charge the pressure reaches 2½ volts, 2 6-10, 2 7-10, 2 8-10, as the case may be—various makes vary somewhat. A voltmeter will show the rate of charge. The density of the solution increases on charge and decreases on discharge. A knowledge of the density at different stages enables the hydrometer to be used as an indicator of how much charge a cell contains.



Plates Assembled.

The densities vary in various makes so that a rule for all cases is not practicable. The positive plate becomes dark chocolate brown when charged, and the negative plate becomes a dark slate grey. Both plates lighten in color as discharge goes on, and this enables those very familiar with storage cells to guess pretty closely at their condition as to charge.

Since part of the energy expended in charge and discharge is dissipated in heating the cells, more energy must be put in than can be made available in return. The per cent. returned is called the watt efficiency and varies in various cells from 60 per cent upward. It may reasonably be doubted that above 80 per cent is ever returned. The highest claim known to be made is 85 per cent watt efficiency.

INTERNAL RESISTANCE.

The large cross section of metal renders this low. To find internal resistance take voltmeter reading when cell is idle. This gives total pressure of cell. Then put cell on discharge with ammeter series with low resistance and note amperes of current. Now measure, with voltmeter, the pressure in external circuit; the remainder of the total pressure is, of course, used up in the cell, so the first voltmeter reading (external pressure) total pressure) minus the second voltmeter reading (gives the internal pressure of the cell. Then since the current is the same inside the cell or outside, and $R=\frac{E}{C}$ (ohms save) the internal

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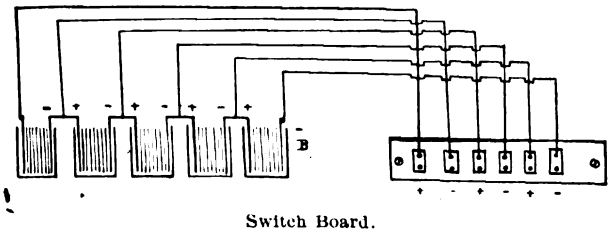
resistance is the internal pressure divided by the internal current, or, expressed as a formula, $\frac{E-E'}{C}=R$, when E is total pressure, E′ is external pressure, C is current, and R is internal resistance. The second voltmeter reading must be taken at the *cell* terminals, *not* at the *switchboard* terminals, else the resistance of the wire leading to the switchboard will cause a serious error. The internal resistance of the battery experimented upon proved by this method to be 1-100 of one ohm per cell. In some cells the internal resistance is only 1-1,000 of an ohm. The size of the plates and the number of plates have much to do with this.

INSTALLATION.

The cells installed were of 150 ampere hours rated capacity. Ampere hour means any equivalent of a flow of one ampere for one hour, as ¼ ampere for four hours, or four amperes for ¼ of an hour. To find ampere hours multiply the number of a nperes that flow by the number of hours during which the flow continues. If a fully charged 150 ampere hour cell is used two hours at a rate of fifteen amperes, then 2x15 or thirty ampere hours have been used and the cell contains only 150—30=120 ampere hours.

The cells had been used to some extent, and been idle for some time. The plates were therefore separated and examined. The insulators (thin sheets of perforated hard rubber) were washed and the fibre paper between the plates was removed. The plates were then replaced in position and new fibre paper was placed next to the positive plates. The insulators were replaced between the plates. The glass jars were thoroughly cleansed and several were then nearly filled with water. Sulphuric acid (pure) was slowly poured into the water (water must not be poured into acid, owing to danger that the acid will spatter explosively) and care was taken to stir the solution as the acid was added. The heat generated by the combination of acid and water was considerable. The addition of acid was continued until the hydrometer indicated 1180 density. The solution was allowed to stand until cold, as warm solution is apt to cause a swelling of the active material. The solution was then siphoned into the remaining jars to the necessary height to cover the plates about half an inch over their upper edges. A stout shelf having been made ready for the reception of the battery, the plates were placed in the jars and the jars were then placed side by side upon the shelf, care being taken to have the positive terminals of each cell next to the negative terminals of the adjoining cells, as will be seen by reference to the switchboard diagram. Student Harold Almert assisted in the experiment and his previous experience with storage batteries proved of value in the work.

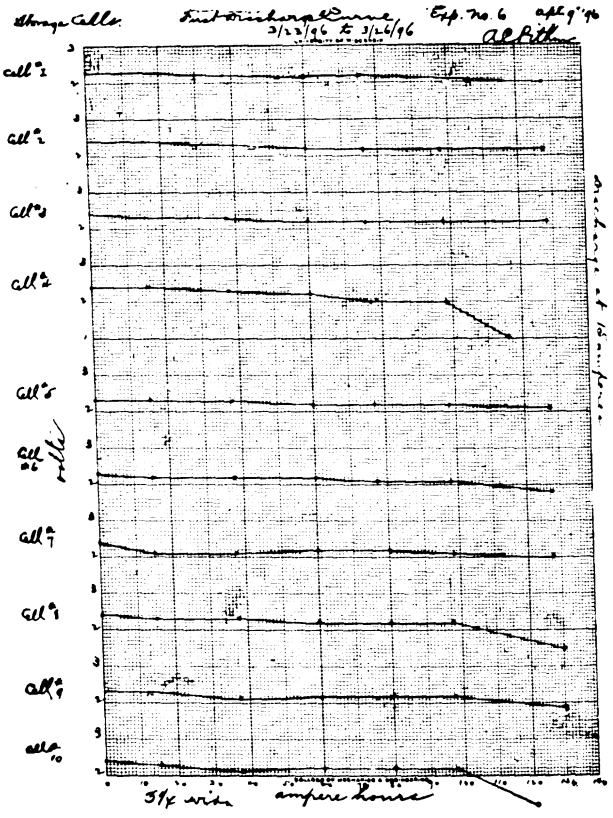


Switch Board.

As storage cells are damaged by standing idle when discharged, the terminals were immediately connected and a charge was begun.

An ammeter was put in series with the Edison circuit and water rheostat and an overcharge was given for the purpose of reducing any sulphate which might have formed during the time that the cells lay idle. The cells were next discharged at the same rate, fifteen amperes, and again charged and discharged to bring them into good working order. About a dozen charges and discharges are deemed requisite to bring a battery to complete efficiency.

No attempt was made, therefore, to calculate the efficiency of the battery. Records were made, at frequent intervals, of the voltage during several charges and discharges and the records were embodied in the form of plates. For one of these in reduced form see accompanying reproduction. The density of the liquid showed considerable rise after charge, and was made 1250 in all the cells. The difference in the density of solution between charge and discharge covered a range of 30 to 40 on the hydrometer scale, some cells showing a greater increase than others for the same charge. Some of the cells did not show up as well as others, but this may have arisen from the fact that as soon as the switchboard was in place (and even before that) students began using current from individual cells. It was impossible to keep track of which cells were so used and to what extent.



Students Miller and Kummer constructed a circuit of No. 14 wire, connecting the two battery terminals with the main switchboard for charging purposes. They also ran a circuit of No. 16 wire some sixty feet, connecting each cell to a switchboard which enabled current to be drawn off at any desired voltage from 2 to 22 (only eleven cells were mounted on the shelf.)

Porcelain insulators were used in both circuits. The switchboard shown in diagram was mounted on porcelain insulators against the south wall close to the switchboard for primary battery. The base of the switchboard is one-half inch hard rubber.

The weight of the cells complete was about fifty pounds each.

Error: In our last issue the mistake was made of crediting Mr. William H. Hale, of Brooklyn, with the title of "Late President of the American Association for the Advancement of Science." The mistake grew out of Mr. Hale's signature as President of a Committee of the Association on some stationery. Mr. Hale has not been presi dent of the association, did not sign himself, so, and naturally is embarrassed by the mistake.

A fellow feeling makes us wondrous kind. Troubles with the trolley cars make the whole world kin. A closer band of sympathy binds us, and why should not the long promised millenium come, when the Chinaman can make bad poetry on the "trolley" and rhyme it with "jolly" at his celestial home in Shanghai, or Foo Chow, just as we do in Greater New York or Podunk.

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NEW ELECTRICAL ASSOCIATION.

National Electrical Association Organized at Chicago—Its Plans and Purposes.

On April 16th last, the Chicago Laboratory Class of the National School of Electricity organized themselves into an association or club, for mutual instruction, improvement and a closer intimacy than the exacting bench work and study at the laboratory would otherwise permit. The association started off with 115 members, the present membership of the laboratory proper. Meetings are to be held every alternate Thursday evening, at the lecture rooms of the School, 335 Dearborn street.

Committees on organization, by-laws, etc., were appointed to report to a subsequent meeting, and on April 23d the organization was completed by the adoption of by-laws, and the election of permanent officers.

The following gentlemen were elected for officers of the club for a term of six months:

MR. J. M. STRODER, President.
MR. A. C. PITKIN, Vice President.
MR. HAROLD ALMERT, Secretary.
MR. A. FONTAYNE, Treasurer.

The committees appointed are as follows:

COMMITTEE ON MANAGEMENT.

MR. J. M. STRODER, MR. HAROLD ALMEET
MR. A. C. PITKIN, MR. A. A. BANNETT,
MR. C. H. MILLER.

COMMITTEE ON PROGRAM.

MR. A FONTAYNE, MR. FRANK J. PORTER, MR. H. HORNIG.

COMMITTEE ON PUBLICATION.

MR. A. H. GEHLE, MR. M. C. KRIEBEL, MR. JNO. S. REESMAN.

Mr. Stroder is Chief of the Board of Examining Engineers of the City of Chicago, and the other officers of the association are identified with practical electricity in one or more of its branches.

Some difficulty was met with in the selection of a name for the association, the question being on the point as to whether it was to be a club proper or one of a series of clubs. It was finally determined to fraternize with other local organizations of the National School of Electricity and the name chosen was The National Electrical Association.

The first working meeting was held on May 7th. Mr. A. C. Pitkin, vice president, and one of the hard workers in the laboratory, read a paper on "A Study of Storage Batteries," which will be found in another part of this issue of the ELECTRICAL JOURNAL.

At the meeting May 21st, at eight o'clock p. m., Mr. Gustav Keil will read a paper upon and demonstrate the "Tangent Galvanometer," using a handsome instrument of his own design. Mr. Keil's laboratory work has attracted the attention of the students by his close application, and his capacity for mastering intricate problems, and any paper he may read will receive most favorable attention. At each meeting similar papers will be read on practical subjects.

Nearly all the members of the laboratory are practical electricians and capable of strong work. With the facilities of a well equipped laboratory at their disposal, it is anticipated that some most instructive work will be done.

The Association has decided by resolution that none excepting members of National School of Electricity shall be received as members, but visitors will be welcome at any of the meetings.

(Signed) COMMITTEE ON PUBLICATION
A. H. GEHLE, Chairman.

SUNBEAM, LAKON AND CUTTER REMOVAL.

The Sunbeam Inc. Lamp Co., Chicago; The Lakon Company, manufacturers of the Lakon Transformer, and The Cutter Electrical and Manufacturing Co., manufacturers of the C-S Switches and I-T E Circuit Breakers, have new Chicago offices at Room 1510 Monadnock Bldg.

ELECTRICITY IN COAL MINING.

Hardly a week passes but news reaches us of the introduction of electricity into some coal mine hitherto operated under the old methods. One of the most recent is that which will be installed by the Scranton Electrical Construction Company at the Mt. Pleasant Colliery, owned by Mr. W. F. Smith, of Scranton. The electrical portion of the plant will consist of one four pole 100 K. W. 650 revolutions, 250 volt generator and one T. M. M. 15 electric locomotive from the works of the General Electric Company.

The colliery is one of the oldest in the vicinity of Scranton, and the gangways over which the locomotive will run pass under the centre of the city of Scranton. The locomotive will be required to haul an average of about 400 cars daily from the counter shutes located along the main gangway, the average length of haul one way being about 3,000 feet. In addition to the haulage plant the coal company will operate from the same wire several rotary coal drills in the same vein.

It may be interesting to know that electricity was selected after competition with manufacturers of steam locomotives to operate in the same mine, and the gangway being driven in four parallel headings it would not have been difficult to connect them to give a separate air split for the steam locomotive. The cost of installing a steam locomotive would have been considerably less than the cost of the electric plant. Notwithstanding this electricty was selected on account of its undoubted advantages and economies in operation over any other system that could be presented.

Another interesting electrical plant is being installed by the Lehigh Valley Coal Company, which operates a large number of collieries in the anthracite district as well as many semi-bituminous mines in the Clearfield region.

The plant consists of one General Electric 150 K. W. 550 volt generator furnishing current to one duplex double-acting Jeansville Mine Pump and one 100 H. P. Lidgerwood friction cone clutch single drum hoist. Both of these machines will be set about 6,000 feet from the generator in the centre of a long slope in the main coal seam. The circuit to the hoist and pump will be carried about 5,300 feet above ground on a pole line, and will then pass down a vertical bore hole 350 feet deep. This part of the line will consist of an iron armored cable, and will be suspended solely by the iron armor.

The pump will have a capacity of 600 gallons per minute, and will lift water through a vertical bore hole to a height of 350 feet. The average work of the hoist will be the hauling of about 15 tons up an eight degree slope at an average speed of 500 feet. The hoist will also be required to lower above five tons down the same slope. The advantages of electrcity are strikingly illustrated in this plant. If electricity had not been selected for the hoist and pump work, it would have been necessary to carry the steam some distance through the mine and provide special bore holes and condensers for the disposition of the exhaust steam.

A BRIGHT YOUNG LAWYER.

The electrical fraternity welcomes to its ranks recently Mr. W. Clyde Jones, one of the bright young lawyers of Chicago. Mr. Jones has been studying and practicing patent law, especially as it concerns electrical patents in the offices of Barton & Brown for some years, and has now gone into business on his own account at 1107 Title and Trust Building. Mr. Jones has been fortunate in his legal experience, and he will find that his clients' interests will be far better looked after than would have been the case if he had gone directly from the "Moot Court" of the law school to the court of law where all is "dead earnest."

Beside patent law, Mr. Jones will give much attention to all the classes of cases, wherein a knowledge of electricity will be an important factor. Insurance cases, trolley car and electric current accidents generally, questions of contract for electrical installations are all among the lines to which Mr. Jones will be able to bring a most excellent mental equipment and experience.

A Chicago motorman has been accused of robbery and locked up. Another time that enterprising individual, before following the lead of his distinguished employer, Baron Yerkes, will reflect that stealing $9.00 is larceny, while stealing a public street is enterprise.

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ELECTRO-THERAPEUTIC DEPARTMENT.

ROENTGENISM BY ROENTGEN.

A Second Communication by the Famous Scientist on Recent Developments.

As my investigations will have to be interrupted for several weeks, I propose in the following paper to communicate a few new results.

At the time of my first communication it was known to me that X-rays were able to discharge electrified bodies, and I suspected that it was X-rays, not the unaltered cathode rays which got through his aluminium window, that Lenard had to do with in connection with distant electrified bodies. When I published my researches, however, I decided to wait until I could communicate unexceptional results. Such are only obtainable when one makes the observation in a space which is not only completely protected against the electrostatic influences of the vacuum tube, leading-in wires, induction-coil, etc., but which is also protected against the air coming from the vicinity of the discharge apparatus. To this end I made a box of soldered sheet zinc, large enough to receive me and the necessary apparatus, and which, even to an opening which could be closed by a zinc door, was quite air-tight. The wall opposite the door was almost covered with lead. Near one of the discharge apparatus placed outside, the lead-covered zinc wall was provided with a slot 4 cm. wide, and the opening was then hermetically closed with a thin aluminum sheet. Through this window the X-rays could come into the observation-box. I have observed the following phenomena:—

Positively or negatively electrified bodies in air are discharged when placed in the path of X-rays, and the more quickly the more powerful the rays. The intensity of the rays was estimated by their effect on a fluorescent screen or on a photographic plate. It is all the same whether the electrified bodies are conductors or insulators. Up to the present I have discovered no specific difference in the behavior of different bodies with regard to the rate of discharge, and the same remark applies to the behavior of positive and negative electricity. Nevertheless, it is not impossible that small differences exist.

If an electrical conductor is surrounded by a solid insulator, such as paraffin, instead of air, the radiation acts as if the insulating envelope were swept by a flame connected to earth.

If this insulating envelope is closely surrounded by a conductor connected to earth, which should, like the insulator, be transparent to X-rays, the radiation, with the means at my disposal, apparently no longer acts on the inner electrified conductor.

The observations described tend to show that air traversed by X-rays possesses the property of discharging electrified bodies with which it comes in contact.

If this be really the case, and if, further, the air retains this property for some time after the X-rays have been extinguished, it must be possible to discharge electrified bodies by such air, although the bodies themselves are not in the path of the rays.

It is possible to convince oneself in various ways that this actually happens. I will describe one arrangement, perhaps not the simplest possible. I employed a brass tube, 3cm. in diameter and 45cm. long. A few centimetres from one end a portion of the tube was cut away and replaced by a thin sheet of aluminium. At the other end an insulated brass ball fastened to a metal rod was led into the tube through an air-tight gland. Between the ball and the closed end of the tube a side tube was soldered on, which could be placed in communication with an aspirator. When the aspirator was worked the brass ball was surrounded by air, which on its way through the tube went past the aluminium window. The distance from the window to the ball was over 20cm. I arranged the tube in the zinc box in such a manner that the X-rays passed through the aluminium window at right angles to the axis of the tube, so that insulated ball was beyond the reach of the rays in the shadow. The tube and the zinc box were connected together; the ball was connected to a Hankel electroscope. It was seen that a charge (positive or negative) communicated to the ball was not affected by the X-rays so long as the air in the tube was at rest, but that the charge immediately diminished considerably when the aspirator caused the air traversed by the rays to stream past the ball. If the ball by being connected to accumulators was kept at a constant potential, and if the air which had been traversed by the rays was sucked through the tube, an electric current was started as if the ball had been connected with the wall of the tube by a bad conductor.

It may be asked in what way the air loses this property communicated to it by the X-rays. Whether it loses it as time goes on, without coming into contact with other bodies, is still doubtful. It is quite certain, on the other hand, that a short disturbance of the air by a body of large surface, which need not be electrified, can render the air inoperative. If one pushes, for example, a sufficiently thick plug of cotton wool so far into the tube that the air which has been traversed by the rays must stream through the cotton wool before it reaches the ball, the charge of the ball remains unchanged when suction is commenced. If the plug is placed right in front of the aluminium window the result is the same as if there was no cotton wool, a proof that dust particles are not the cause of the observed discharge. Wire gauze acts in the same way as cotton wool, but the meshes must be very small and several layers must be placed one over the other if we want the air to be active. If the nets are not connected to earth, as heretofore, but connected to a constant-potential source of electricity, I have always observed what I expected; however, these investigations are not concluded.

If the electrified bodies are placed in dry hydrogen instead of air they are equally well discharged. The discharge in hydrogen seems to me somewhat the slower. This observation is not, however, very reliable on account of the difficulty of securing equally powerful X-rays in successive experiments. The method of filling the apparatus with hydrogen precluded the possibility of the thin layer of air which clings to the surface of the bodies at the commencement playing an appreciable part in connection with the discharge.

In highly-exhausted vessels the discharge of the body in the path of the X-rays takes place far slower—in one case, it was, for instance, 70 times slower— than in the same vessels when filled with air or hydrogen at atmospheric pressure.

Experiments on the behavior of a mixture of chlorine and hydrogen, when under the influence of the X-rays, have been commenced.

Finally, I should like to mention that the results of the investigations on the discharging property of the X-rays, in which the influence of the surrounding gases was not taken into account, should be for the most part accepted with reserve.

In many cases it is of advantage to put in a circuit between the X-ray producer and the Rhumkorff coil a Tesla condenser and transformer. This arrangement has the following advantages:—Firstly, the discharge apparatus gets less hot, and there is less probability of its being pierced; secondly, the vacuum lasts longer (at least this was the case with my apparatus), and thirdly, the apparatus produces stronger X-rays.

In apparatus which was either not sufficiently or too highly exhausted to allow the Rhumkorff coil alone to work well, the use of a Tesla transformer was of great advantage.

The question now arises—and I may be permitted to men-

By Professor Wilhelm Konrad Roentgen, Wurzburg Physikal Institut d. Universitæt.

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tion it here, though I am at present not in a position to give an answer to it—whether it be possible to generate X-rays by means of a continuous discharge at a constant discharge potential,or whether oscillations of the potential are invariably necessary for their production.

In my first communication it was stated that X-rays not only originate in glass, but also in aluminium. Continuing my researches in this direction I have found no solid bodies incapable of generating X-rays under the influence of cathode rays. I know of no reason why liquids and gases should not behave in the same way.

Quantative differences in the behavior of different bodies have, however, revealed themselves. If, for example, we let the cathode rays fall on a plate, one half consisting of a 0:3mm. sheet of platinum and the other half of 1mm. sheet of aluminium, a pin-hole photograph of this double plate will show that the sheet of platnium emits a far greater number of X-rays than does the aluminium sheet, this remark applying in either case to the side upon which the cathode rays impinge. From the reverse side of the platinum, however, practically no X-rays are emitted, but from the reverse side of the aluminium a relatively large number are radiated. It is easy to construct an explanation of this observation, still it is to be recommended that before so doing we should learn a little more about the characteristics of X-rays.

It must be mentioned, however, that this fact has a practical bearing. Judging by my experiments up to now, platinum is the best for generating the most powerful X-rays. I used a few weeks ago, with excellent results, a discharge apparatus in which a concave mirror of aluminium acted as cathode and a sheet of platinum as anode, the platinum being at an angle of 45 degrees to the axis of the mirror and at the centre of curvature.

The X-rays in this apparatus start from the anode. I conclude from experiments with variously-shaped apparatus that as regards the intensity of the X-rays it is a matter of indifference whether or no the spot at which these rays are generated be the anode. With a special view to researches with alternate currents from a Tesla transformer, a discharge apparatus is being made in which both electrodes are concave aluminium mirrors, their axes being at right angles; at the common center of the curvature there is a "cathode-ray catching" sheet of platinum. As to the utility of the apparatus I will report further at a later date.

STUDY OF ISOLATED NERVE.

Electro-Chemical and Electro-Physiological Reaction in Normal vs. Abnormal Fissue.

The present investigation arises from experiments undertaken to determine autographically the varying relations between the magnitude of electrical change and the magnitude of stimulation in nerve under various chemical conditions.

The main principle upon which the inquiry is based is the proposition established (by Du Bois-Reymond, and by Hermann in partlcular) to the effect that disturbed protoplasm is electro negative to the normal. An accessory principle, to which reference will also be made, is that upheld (by Hering in particular) to the effect that protoplasm in which disturbance has just ceased is electro-positive to the normal. In accordance with the first principle, injured is electro-negative to normal protoplasm, and excited is electro-negative to resting protoplasm. In accordance with the second principle, recently excited is electro-positive to normal protoplasm.

Nerve (the excised and still living nerve of the frog) is, for the purpose of this inquiry, considered as a convenient stand of excitable yet hardly exhaustable protoplasm, giving off to the galvanometer a demarcation or injury current (Hermann) from a less disturbed portion (longitudinal surface L) to a more disturbed portion (transverse section T), which current, during disturbance of the whole nerve affected by weak tetanisation at the two exciting electrodes, but principally affecting a less disturbed portion L, undergoes a negative variation (Du Bois-Reymond), the magnitude of which is taken as the index to the magnitnde of chemico-physical change aroused in the nerve under various chemical conditions.

Care is observed to avoid the ordinary fallacies and to obtain a "negative variation" as far as possible clear of electrotonic effects. Action-currents (significant physiological effects in nerve) are distinguished from physical effects by means of anæsthetics, CO_2, Et_2 O, $CHCl_3$.

The physiologival state of the nerve is tested by tetanising currents of low and uniform intensity, of uniform duration (7½ sec., and later 15sec.), at uniform intervals (I min.), in both directions. The serious native variations or action currents led off to the galvanometer, gives a corresponding series of deflection, which are registered on a slowly-descending photographic plate.

The plan of procedure adopted throughout has been to take for a period a normal series of deflections, then to submit the nerve to the action of a reagent (without removal from the electrodes in the case of gases, but with such removal in the case of solutions), finally to take for a further period the series of increasing or decreasing or reversed deflections of the chemically modified nerve. Alterations of resistance were controlled by aid of a standard deflection of 0.001 volt let into the nerve and galvanometer circuit at beginning and end of experiment.

The result so far acquired may be considered under the following heads:– (1) The effects of anæsthetics and of some gases. (2) The effects of several chemical substances in solution. (3) The effect of carbon dioxide. (4) Theoretical considerations.

(1) *Anæsthetic vapours* were employed at the outset of these observations with a view of distinguishing between physiological and physical effects.

(2) *Action of Reagent Soluble in Normal Saline.*—The nerve is bathed for one minute in more or less dilute solutions (acids, alkalis, neutral salts) and replaced upon the electrodes. Distilled water gradually abolishes excitability. Dilute acid solutions, M\40 to M\10, cause primary augmentation, followed by gradual diminution. Stronger acid solutions, M\10 to M\5, cause primary diminution and abolition.

Alkalis.—Caustic potash is far more active than caustic soda. Potassium salts are more active than sodium salts.

Neutral Salts.—The influence of the base predominates in a total action due to the entire molecule. Calcium chloride in M\10 solution augments the electrical response, and antagonizes potassium chloride, which diminishes or abolishes it. Mercuric chloride is the most lethal of any salts hitherto tested; its M\100 solution abolishes the response. Isomeric compounds differ in efficacy.

Abstract of a lecture by Augustus D. Waller, M. D., F. R. S., before the Royal Society.

ELECTROSE MANUFACTURING CO. MOVES.

The Electrose Mfg. Co., formerly situated at 216 William St., owing to the constantly growing demand for their wares were again compelled to seek larger quarters, and removed May 1st to 127-137 N. 10th St., Brooklyn, N. Y.

They have there some 13,000 square feet of floor space, and with a largely increased plant are in a position to promptly meet larger demands for their substitute for hard rubber than they have been heretofore.

A MOUNTAIN ELECTRIC ROAD.

Mr. F. G. Plummer of Tacoma, Washington, is at the head of an engineering corps, locating a railway line across the mountains. It is proposed to operate the road by electricity, the power to be drawn from the rapids and rivers along its course.

The high mercury, the appearance of straw hats on the street, and the bugs dying around the electric lights at night are sure evidence that hot weather has come to stay.—Springfield, Ill., *News.*

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RŒNTGEN RAY IN SURGERY.

A Study of the New Science from a Utilitarian Standpoint.

BR DR. OLIVER LODGE.

The applications to surgery and anatomy are growing so important and interesting that they have some tendency to delay progress in the direction of a better understanding of the physical nature of the Rœntgen rays. The focus-tubes now in the market are able to stand as much power as can be applied to them by an induction coil with make-and-break. Alternating currents as exciter are unsuitable; a quick sharp break is much the best. Leyden jars are quite unnecessary. A low-resistance primary, excited by two or by three storage cells and a break under alcohol, acting on a large secondary coil, are the means which I have found best for exciting the tubes. A well-exhausted tube can stand for hours discharges which are on the verge of leaping across its terminals outside the glass, and can keep quite cool all the time, although the primary contact-breaker may get partly melted. The vacuum improves in action and ultimately gets too good, so that the discharge occurs altogether outside the bulb. In that case the flame of a Bunsen suffices to liberate condensed gases from the glass and give the bulb a new period of activity. Rays so obtained are very penetrating, and make such bodies as potassium-platino-cyanide and calcium-tungstate fluoresce powerfully. These two substances are the best I have yet seen, and the second is much the cheaper, even if the former is the better, as I incline to think it is. Neither should be powdered, but should be thrown down in minute crystals, and these, when dry, should be spread on a layer of clear varnish painted over either tracing-cloth or glass. Several such layers of crystals superposed give a good screen, which, mounted as the base of a box with two eyeholes at the distance of distinct vision in dim light, enables the effect of even feeble Rœntgen rays to be readily seen. Of course, actual light is to be excluded by two or three thicknesses of photographic black paper or otherwise. Armed with such a spy tube, and having accustomed the eye to a dark room for some time, the screen can be seen to fluoresce under the action of rays which have penetrated considerably more than a foot thickness of solid pitch-pine. The rays which have penetrated a person's chest also have the power of exciting vivid fluorescence. Indeed, under favorable conditions, the rays which have been through one person can be sent through another, and their effect can still be seen after that. Of course, clothes make no practical difference. It is rather less easy to see through a head than through a chest, but it is quite easy enough to see through every part of the body when things are working well, but in no case have I as yet been able satisfactorily to perceive any detail by this method of viewing. Whether it be merely that the light is too dim for discrimination, though apparently rather bright, or whether it be that these very penetrating rays make less distinction than ordinary rays between bone and other less dense material, I am not sure. Possibly there is truth in both these obvious suggestions. It would not be easy to read a page no more strongly illuminated than is the fluorescent screen after the rays exciting it have penetrated the trunk, and perhaps the absence of detail is thus sufficiently explained; but I have been several times forced to surmise that just as the original Lenard rays are easily stopped by a few inches of air and have feeble penetrating power, so Rœntgen rays may be of two or more kinds, perhaps differing in something of the fashion that violet light differs from red; and that, whereas close to the source we get Rœntgen and Lenard rays mixed, and a little further off Rœntgen rays only—that is, those which discriminate most clearly and throw therefore the most instructive shadows, so after great obstruction, like a human body, only the most penetrating quality of ray gets through. And under these circumstances the interposition of the palm of one's hand scarcely adds to the shadow, nor do the bones of the palm make their appearance in so prominent a manner as one might expect from the general brightness. Against this, however, is to be recorded the fact that I have taken a photograph of a spine to discover the nature of the damage to a vertebra in a patient, and the details of the processes of the vertebrae come out well. Also I have taken a hand with rays which have come through six inches of pitch-pine, and the bones, though a little blurred, are not bad.

Naturally the body radiographs are not easy to read, except by a skilled anatomist after some practice, because the aspect of bones which are semi-transparent, and are all projected together upon a flat surface, is by no means a usual aspect, indeed is a quite novel one, and requires to be learned. A study of the skeleton, and some skill in drawing, is necessary in order to disentangle the superposed impressions. But the impressions themselves are not indistinct. The internal organs also appear. Comparing this method of investigation with the stethoscopic method it cannot be thought that the stethoscope is the easier. To a novice both would seem equally puzzling, and both require skill and experience.

Foreign metallic bodies in the trunk, such as a Murphy button used by surgeons for joining cut intestines, are, of course, easily radiographed. The other day I got a good impression of one of these in an adult, with only ten minutes' exposure of the plate.

But here again some evidence of possible physical interest occurs. The outline of the button, naturally at some distance from the flat, is not sharp. Its shape is quite visible, but its outline is blurred. Of course, it is enlarged by the cone of rays, and its position between plate and source could be estimated exactly by its size, if only its outline were sharp. Possibly the blurring is only due to internal movements in the body, the intestines are known to be very movable; but if, as Lenard said, opacity is the nature of turbidity, the whole body glowing as it were like faintly ground glass under the action of the rays, which is just what it looks like through the described spy-tube, then this slight haziness of outline may be considered as physically explained.

A coin laid upon each plate serves as a handy label and a guide in developing. It may be worth remarking that a three penny bit placed on top of a shilling comes out readily on a plate; and that one can "see" through several thicknesses of sheet iron such as tin plate.

As to the photographic plates used, I have found that only plates by the best makers are of any use. A cheap packet, in which some of the plates may have been already partially fogged, is utterly unsatisfactory. Hitherto Edwards' isochromatic plates have done best for me, though Marion's rapid, and probably any thoroughly good maker's, are equally good; and I do not now fancy that the isochromatic property is an essential help. Either the hydroquinone or the pyrogallate developers are perfectly satisfactory, but my assistant usually prefers the hydroquinone. In developing the plates it must be remembered that the penetrating power of the rays has enabled them to operate equally right through the film, and not chiefly on the surface; hence development may be safely pushed pretty far. This fact may have given rise to the opinion that the films are acted on from the glass outwards, instead of from the surface of the film inwards, as in the case of light. At present I am not by any means convinced of the truth of this opinion.

It would, however, be very remarkable if that interesting experiment of Prof. J. J. Thomson's should be confirmed—namely, that the cathode rays themselves inside a vacuum had no power of exciting a photographic plate. From their violent action on glass it would seem more likely that their action, though admittedly indirect, must nevertheless be strong, perhaps strong enough to undo and mask their initial effect. At any rate the experiment needs repeating.

As to the source of the rays, I, like others, have made many experiments, and the results are definite enough. When the rays from the cathode, inside the vacuum, impinge first on a glass surface, then that surface is the source. It is not as if the cathode rays penetrated the glass and proceeded on their path; it is not as if the glass surface were a wave front, from every point of which a ray proceeded normally; the glass radiates X-rays just as a red hot surface radiates light. From every point a cone of rays starts in all directions, and there is no mutual interference in the lateral directions, as there would be between a number of similar sources all in the same phase. Every point of the glass radiates independently—like a hot surface, in fact. The best experiments of this kind were those in which I used a magnet to deflect the cathode rays on to any chosen spot or patch of the glass, and then took shadow photographs through slits and holes placed at a measured distance. The shad-

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ows of wires at a distance from the plates, taken through a narrow slit at some distance from the wire, show that if the X-radiation consists of waves at all those waves must be very small. There has been nothing, as yet, to discriminate between longitudinal and transverse oscillations. Transverse must be considered as the most probable at present; but then it is not certain that they are waves at all. If waves they must be very small ones; and the question whether they are transverse or longitudinal is almost a minor consideration, if it should turn out that the wave-length is comparable to the size of molecules. The interest and importance of such an instrument of investigation as radiation with that size of wave, whereby indirectly molecules themselves would hereafter be rendered diffractionally visible, are immense.

When the cathode rays do not first strike the glass, but first strike a piece of metal enclosed in the bulb, then its behavior depends largely on what it is connected to. My experiments on this point are not complete, but this much is certain, that if the bombarded piece of metal is attached to the cathode, so that it is unable to receive any electrical charges from the cathode stream, then it either declines to act as a source of rays at all, or else emits a radiation of the most feeble kind, which can without difficulty be attributed to a secondary cause. But on the other hand, if the bombarded disc be connected to the anode, so as to be able to receive the negative charges of the cathode stream, then it acts as a most vigorous source. In a low state of vacuum it will indeed get hot and radiate light, but in a high vacuum every part of the bulb keeps perfectly cool, and the whole energy supplied seems to pass off in X-rays.

The following experiment is worth quoting at greater length.

A bulb like this with concave electrode, having at its centre a rather thick aluminium plate connected to it metallically (wires protected by glass), and beyond in its shadow the other electrode, was excited either with the cup as cathode or with the cup as anode, and pinhole photographs were taken simultaneously from various points of view, and at measured distances. A glass plate was subsequently put in the position of each of the sensitive plates, and the appearance of the tube as seen through the "pinholes" (which were one-quarter inch in diameter), by an eye roving about, were drawn in ink upon the glass. The eye-picture thus obtained was afterwards compared with the developed images, and the sources of the radiation thus clearly observed.

When the small flat disc was cathode, every part of the complicated anode appeared strongly and quickly on the plate, especially the tilted and first bombarded portion on a plate placed above the tube. The cathode disc itself did not show at all. On a plate placed below the bulb the anode cup appeared strong, but the tilted disc did not appear. On the other hand, it threw a sharp faint shadow of the hole, showing that its focus acted as a feeble point source, by reason of a few rays reflected back on to it from the cup.

When the current was reversed, the small disc anode showed faintly, being excited by rays which had penetrated the interposed tilted disc, but again the cathode hardly showed at all, not even the titled portion on a plate placed below the bulb. By giving a very long exposure (two hours) some impression was obtained, about equal to that from the shaded anode disc; but, of course, if the tilted plate had been under these circumstances an anode, it is well known that a few minutes would have sufficed to show it strong upon the plate beneath.

Hence undoubtedly the X-rays do not start from cathode or from anything attached to the cathode, but do start from a surface upon which the cathode rays strike; whether it be an actual anode or only an "anti-cathodic" surface. Best, however, if it be an actual anode. I suggested the term "anode-rays," therefore, while Prof. S. P. Thompson prefers the term "anti-cathodic rays;" but probably the term used by Rœntgen is still the best at present.

When the glass walls, instead of receiving cathode rays, are pierced only by the true Rœntgen rays from the disc in the middle, no evidence is afforded by my photographs that the glass under these circumstances acts as a source. It is well that it does not, for its only effect would be a blurring one. With focus tubes the glass phosphoresces under the action of the anode or X-rays, as anything else would phosphoresce, but its phosphorescence is not of the least use. It is a sign that the tube is working well, and that the rays are powerful, but if by reason of fatigue the glass ceases to phosphoresce strongly, the fact constitutes not the slightest detriment. Not even when the glass itself is the first bombarded thing, and therefore itself the source of the Rœntgen rays, does its fatigue make any difference. The fatigued portion of glass looks dim and unsatisfactory, while if by means of a magnet the rays are drawn aside from the fatigued patch on to a fresh portion of glass, the fresh portion looks bright and active; but the only radiographic result is that the source has shifted in position, as can be seen well enough by the shadow-parallax of suitably-disposed objects on a fluorescent screen; but no difference in brightness occurs. The fresh piece of glass glows brightly, and emits much more light; but it emits no more X rays than the fatigued portion. I emphasize this statement because the contrary has several times been asserted.

The phosphorescence of the glass bulb is handy as an index, but it has no further advantage. The quality of the glass is doubtless of some importance, the lighter and thinner the better, one would suppose; and I doubt if very much advantage will be gained by replacing it with aluminium. I must say, however, that tungstate of calcium seems to me notably opaque to X-rays, and hence a non-fluorescent substance, or a less fluorescent substance than glass, may be really better for the walls of the tube. I anticipate that the use of uranium or other such glass would be a step in the wrong direction.

All the observations of the discoverer have been confirmed by subsequent experiment, and the only additions that I am aware of to the list given by him are:

1. The focus-tube; which is an old pattern of Mr. Crookes' merely more highly exhausted. I first saw it at work in Prof. Carey Foster's laboratory at University College, London, last January, and that particular tube still gives about the best defined results possible.

2. The use of potassium instead of barium-platino-cyanide, or more recently the use of calcium-tungstate, as the fluorescent screen. Mr. Sydney Jackson, of King's College, seems to have done excellent and most useful work in this entire subject of fluorescence, as well as in helping every one to acquire good and well-made focus-tubes by getting them put upon the market in a thoroughly well-exhausted condition.

3. The discovery of J. J. Thomson that the rays make insulators conduct.

It is sometimes spoken of as new that the rays discharge electrified bodies, but Lenard observed that in 1894. What had not been previously discovered was the reason why they do this. Many observations, more or less fanciful I think, have been made as to whether positively or negatively charged bodies are discharged most rapidly; any such observation, to be dependable, requires extreme precaution, even if there were not the complication that nothing can be depended on to insulate when exposed to the stream of rays.

There is here evidently a large field for investigation, but any new results should be received with extreme caution, inasmuch as experiments on electrostatic discharge are open to such a variety of disturbing causes at the best of times.

It may be of interest to state that Prof. J. J. Thomson's discovery that the known discharging power of these rays for both positive and negative electricity is to be explained by the fact that they render insulators conductive, has been verified in my laboratory for one or two substances; but any differences between positive and negative discharge, and any difference between one kind of metal and another, remain in my judgment seriously open to doubt.

Another fact may as well be noted—viz., that platinum foil kept white hot by an electric current has practically the same degree of opacity as a cold piece. Five pieces cut from the same sheet were compared simultaneously; they were of different breadths and had the same current flowing through most of them, so that one was white-hot and one was cold, and the others were at intermediate temperatures, but there was no appreciable difference in their transparency. This, of course, tends in the usual direction of emphasizing the importance of mere density; for hot and cold platinum must be considered as of appreciably the same density for the purposes of this experiment.

The crop of assertions about the detection of X-rays from all manner of absurd sources has somewhat dwindled of late, and the loss is a bearable one. A serious attempt must be made to observe

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if the sun emits them by exposing suitable objects, such as bullets imbedded in cork, in front of protected plates on mountain tops this summer. The atmosphere, being equivalent to over two feet of mercury, must entirely screen these rays from lower levels; but Alpine tourists have often reported a strange fogging of plates, which they have been disposed to attribute to the warmth of a guide's back!

The production of the rays has now reached a considerable pitch of perfection; there remains much good work to be done in the direction of their better detection, especially in their more rapid photographic fixing. It is true that a few flashes will now give a radiograph of a hand, but nothing comparable to the snapshot exposure which has been achieved in the case of light can yet be predicated of the X-rays. Their fluorescing power seems to show that they possess plenty of energy, and, of course, many attempts have been made to utilize this property directly, so as to make films more sensitive.

If the films themselves can be made to fluoresce, without otherwise being damaged, it may be a step in the right direction; but, so far as my experience goes, which is not far, a coating of fluorescent material near the film tends rather towards a scattering and diffusion of light—a poor exchange for the straightforward penetrating property of the X-rays themselves.

Nothing better than Roentgen radiation has ever been got for throwing clear sharp shadows and giving a dense clear image. Rays which cannot be refracted, nor apparently diffracted, nor even reflected to any appreciable extent, are splendid for bringing out sharp details, and any exchange of them for the diffuse glow of any kind of phosphorescent light may be a step backwards. Nevertheless, it is improbable that the present plates, put into the market for one purpose, are the best that can be devised for an altogether different, though allied, purpose, and much work of a somewhat empirical kind remains to be done by photographic manufacturers or amateurs before the most suitable kind of film is discovered.

MICA MINES OF THE WORLD.

Mr. Franklin Brooks, junior member of the firm of Eugene Munsell & Co., 218 Water St., New York, miners and importers of mica, was welcomed home from his trip abroad by his many friends. The features of the trip were discussed at the dinner which was tendered him with greater interest than the menu. Mr. Brooks has been away some six months on a business and pleasure trip, including in his itinerary London, Paris, Monaco, and then through the Mediterranean Sea and Suez Canal to India, where he spent two months in the Mica fields, in which the company is largely interested. He has brought home a large number of photographs, which are very interesting and which have been procured at a great deal of expense. After having disposed of his business in the mica field, he visited Calcutta, and also spent some time in China and Japan; then crossing the Pacific to Vancouver and stopping at San Francisco and Chicago before reaching New York.

Mr. Brooks covered in the neighborhood of 40,000 miles in his travels. Some idea is gained of the magnitude of the mica fields from the fact that Mr. Brooks travelled about 4,000 miles in that section of India alone. The firm import mica direct from the mines and Mr. Brooks has completed arrangements whereby they are in a position to supply mica to the electrical trade in larger quantities than heretofore.

ELECTRICITY IN SOUTH AMERICA.

The South American Light, Power and Traction Company, of Lima, Peru, has just placed a contract with the General Electric Company of New York, for the installation of a 5,000 H. P. electrical plant. The dynamos will be erected at the waterfalls, eleven miles from Lima, and the electric power generated will be transmitted to the city, where it will be used to operate the surface railways and electric lights and furnish to the public generally such electric power as may be required.

This will be the largest installation of electricity in South America.

ALTERNATING CURRENT MEASUREMENT.

THE ELECTRICAL JOURNAL, Chicago, Ill.

Mr. Editor, Dear Sir: If it is not too late I should like to make a few remarks on Dr. Monell's article which you published some time ago, in which he says that no manufacturer made a faradic apparatus in which the interrupter was run by a separate current. In your issue of Jan. 15 you have given the International System of Electro-Therapeutics a very nice notice. If Dr. Monell is interested in Faradism it will pay him to read Dr. Geo. J. Engelmann's article on the subject in the above book. Dr. Engelmann describes a faradic apparatus which will give from one to one hundred and fifty thousand interruptions or alternations per minute, and makes a record up to 1,600,000. The current for the interrupter is separate from that used in the primary coil. I do not believe it possible to make a meter for the faradic current—by that I mean a meter that will give any idea of the effect of the current. It is an easy matter to make a volt or milli-ampere meter for the faradic current, but even using both will not tell the character and effect of the current, as it depends upon the rate of interruption. For instance, suppose you are using a current of one hundred volts, one-one hundredth of one milli-ampere and fifty interruptions per minute, you will get a certain effect; now simply change the rate of interruption to 150,000 per minute; you will get an entirely different effect, yet the voltage and current are the same in each case. The only way to get at something definite is for the electrical society to appoint a committee of physicians who use the faradic current and who have won honors by their original work, such men as Drs. A. L. Ranney, Geo. J. Engelmann, L. L. Dana, W. J. Herdman and others equally well known. All manufacturers would gladly send apparatus to such men and make whatever changes were suggested by them. Then at the end of the year let them report the result of their work. *Not recommend any one make of battery*, but simply *state how* the Standard battery should be made—by that I do not mean the form or style, but for example the Standard battery should be made as follows:

1. The interrupter run by a separate current and some arrangement for counting the rate of interruption.
2. A certain number and a *certain make* of open air circuit batteries.
3. A milli-ampere meter and a rheostat in the primary circuit, so that the current can be kept at a certain number of milli-amperes.
4. A certain *length* and *diameter* of iron core in primary.
5. A certain size wire and number of turns in primary coil.
6. Certain secondary coils.

All the above to be made as recommended by the committee. If that is done then each manufacturer can make the battery in any style he sees fit, and he will find ample room to display his inventive mind in making the battery as simple and attractive as possible. To give an idea of the effect of the above battery it will be necessary to record five things:

1. Number of cells in primary circuit.
2. Number of milli-amperes in primary circuit.
3. The secondary coil.
4. The distance the secondary covers the primary.
5. The rate of interruption.

Hoping the above will prove of interest to some of your many readers and that the discussion on the measurement of the faradic current will be renewed, I remain

Yours very truly, HARRY F. WAITE.

113 East 31st street, New York City.

New Yorkers look forward with great hopes to the completion of the electrical equipment that is to give them power from Niagara Falls. They have evidently come to understand that if they are to "get a move on" to keep up with the national procession the energy must come from somewhere else—and the call for Niagara plainly expresses the belief that a big supply will be needed.

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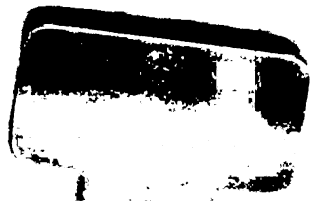

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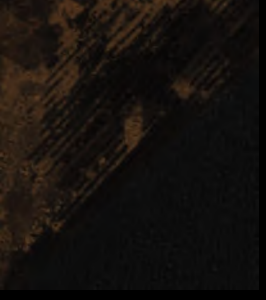

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